No. 454

In the Supreme Court of the United States

October Term, 1960

United States of America and Atomic Energy Commission, petitioners

v.

International Union of Electrical, Radio and Machine Workers, AFL-CIO, et al.

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

REPLY BRIEF FOR PETITIONERS

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REPLY BRIEF FOR PETITIONERS

The central issue in this case is whether the procedure followed by the Atomic Energy Commission to protect the public health and safety in connection with the PRDC Reactor accords with the Atomic Energy Act of 1954. The Commission held a hearing on the PRDC application for a license to construct and operate the Fermi reactor and found (R. 708):

> reasonable assurance in the record, for the purposes of this provisional construction permit, that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and

> operated at the location without undue risk to the health and safety of the public.

The Commission thereupon issued a provisional construction permit. It also announced that it would not issue a license to operate unless it was demonstrated at a further hearing that the reactor as finally designed would be operated without danger to the health and safety of the public (R. 712, 718–719).

In our opinion this procedure conforms exactly to the Commission's regulations and its consistent practice in other cases involving large developmental reactors. Consequently, our main brief is chiefly concerned with the interpretation of the Atomic Energy Act.

Respondents have introduced a diffuse variety of additional questions. Although the only order under review is the order dated May 26, 1959, continuing the construction permit, as amended, they attack the original provisional construction permit issued August 4, 1956. It is now necessary, therefore, to give the Court a brief account of that aspect of the proceeding. See pp. 3–7, *infra*.

Respondents also argue that the Commission's findings in this case do not conform to its own regulations. The argument [illegible] based partly upon contentions concerning the meaning of the regulations and partly upon respondents' interpretation of the Commission's findings, which varies from time to time throughout its brief. Since the meaning of the findings must be established before one can determine whether the findings conform to the regulations and

the statute, we shall also discuss this issue before turning back to the central question in the case. See pp. 7–19, *infra*.

Finally, since respondents appended to their brief a list of so-called "accidents" at atomic reactors, we shall discuss the extraordinarily high safety record of this field of activity. See pp. 41–45, *infra*.

I

THE PROPRIETY OF THE ISSUANCE OF THE ORIGINAL CONSTRUCTION PERMIT IN 1956 IS IRRELEVANT TO THE ONLY ISSUE BEFORE THE COURT, NAMELY, THE VALIDITY OF THE 1959 AMENDED CONSTRUCTION PERMIT

The PRDC application was filed on January 6, 1956. Under the Act and regulations at that time, the Commission was authorized to issue provisional construction permits without a hearing provided that it gave any protestants an opportunity to be heard upon request filed within 30 days after issuance. The Commission referred the application to the Advisory Committee on Reactor Safeguards. The Committee reported (R. 587–593) that there was insufficient information available at that time to give assurance that the PRDC reactor could be operated at the site without public hazard and that it was doubtful whether even an accelerated program of research and development would give the assurance before the scheduled completion of the reactor in the summer of 1959. The Commission conducted further investigations and on August 4, 1956, granted a provisional construction permit (R. 516–523). Commissioner Murray dissented.

There was sharp criticism of this procedure from the Joint Congressional Committee on Atomic Energy and in Congress, both because the Commission had issued a construction permit without a hearing and also because it had acted in the face of a discouraging ACRS report.[1] The Atomic Energy Act of 1954 was subsequently amended to require a hearing before the issuance of construction permits, to provide a statutory basis for the Advisory Committee's activities, and to require that its report be made public. The handling of the PRDC Application at this stage and especially the alleged suppression of the ACRS report[2] became an item in the political contest over the

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[1] A full explanation of the considerations that led the Commission to issue the original permit, including its analysis of the ACRS report, is contained in a 1956 letter from the Commission to the Joint Committee on Atomic Energy, set forth at pages 136–155 of *A Study of AEC Procedures and Organization in the Licensing of Reactor Facilities*, 85th Cong., 1st Sess. (Joint Committee Print 1957).

Respondents state (Br. 17, n. 15) that the PRDC project has not, since the 1957 legislation, been referred to the Advisory Committee. While no formal reference is required until application is made for an operating license (Section 182(b)), the Advisory Committee has been regularly reviewing the PRDC project to date, and its subcommittee has had periodic meetings with the AEC staff and PRDC personnel. *Improving the AEC Regulatory Process*, 87th Cong., 1st Sess. (Joint Committee Print 1961), Vol. 2, pp. 177–179. A formal report will be rendered by the Advisory Committee prior to the hearing upon an application for an operating license.

[2] The Commission's uniform policy, until the 1957 legislation, was to consider such communications from the ACRS as internal documents protected by executive privilege. See *Improving the AEC Regulatory Process*, *supra*, Vol. 1, pp. 447–448.

nomination of Commissioner Strauss to be Secretary of Commerce.

Three points concerning this initial phase of the PRDC proceeding should be clearly understood.

1. The original provisional construction permit is not before this Court. After the original phase was completed, the ACRS report was released, and a full hearing was held. The Commission made specific findings concerning the safety of the Fermi reactor upon new and more complete evidence. Not even Respondents argue that any mistakes in the original issuance of the provisional construction permit invalidated the order under review. And whatever may be the merits of that earlier controversy, it involved no violation of the statute.

2. The report of the Advisory Committee on Reactor Safeguards casts no doubt upon the Commission's finding that there is reasonable assurance that a reactor of the general type proposed in the PRDC application can be constructed and operated safely at Lagoona Beach. More than two years had intervened between the ACRS report and the Commission's findings after the hearing. During this period atomic science and engineering were developing with great rapidity. The completion date for the PRDC reactor had been set back, thus allowing more time for research and development. The Chairman of the Advisory Committee on Reactor Safeguards testified at the hearing that although there was not then sufficient proof of its safety to permit a reactor of the type proposed to be operated at Lagoona Beach, it

was "very probable that the necessary information will be obtained" (R. 674). Dr. Harvey Brooks, an ACRS member, testified that there was reasonable assurance that such information would be available in time to meet the PRDC time schedule and that it would furnish the necessary assurance "that the PRDC reactor can be operated at a site such as that proposed without undue hazard to the health and safety of the public." Other ACRS members testified to substantially the same effect (R. 674–75).

3. The Congressional criticism of the handling of the PRDC case which is cited by respondents does not refer to the issues involved in the present case but to the procedure followed in the issuance of the original provisional construction permit. Thus, the material under the heading "Pertinent amendments to the Act after issuance of original construction permit" (Resp. Br. 15–17) is relevant, at most, only to the issuance of the original permit, and has nothing to do with the issues before the Court. Similarly, the colloquy between Senator Anderson and Commissioners Wilson and Olson (Resp. Br. 55–56), in which the Commission's handling of the Fermi project was criticized, related to the original issuance of the permit in 1956, not to the permit here under review. This is also true of the cited Congressional criticism of the Commission's failure to make public the ACRS report (Resp. Br. 61–62), and the statements by Senator Anderson and Representative Holifield criticising the Commission for not having held a hearing before issuing the permit (Resp. Br. 5, n. 5; 61–63).

In short, all of the Congressional criticism that respondents stress so heavily related to an issue not involved in this case—the issuance of the original permit in 1956. The only issue before the Court is the validity of the amended construction permit issued in 1959, and that depends upon what was done in issuing it, not upon what happened in the earlier proceedings involving the superseded permit. Cf. *Inland Empire Council* v. *Millis*, 325 U.S. 697, 706–710; *Federal Broadcasting System* v. *Federal Communications Commission*, 225 F. 2d 560, 563, 564–565 (C.A. D.C.), certiorari denied, 350 U.S. 923.

II

THE COMMISSION'S FINDINGS SATISFIED THE REGULATIONS

Respondents' argument that the Commission's findings satisfy neither the regulations nor the statute rests upon shifting grounds. At times they seem to acknowledge that the findings relate to both the construction and operation of the reactor but contend that the findings are denigrated by the Commission's statement that the findings were made for the purposes of issuing a construction permit (see Brief for Respondents, pp. 11–12, 14–15, 52, 70–71, 72–73, 78–79). At other times they seem to argue that the findings relate only to the construction and not to the operation of the reactor, and, for this reason, fail to satisfy the regulations (see Brief for Respondents, pp. 46–49, 57, 59, 60–61, 72, 78, 80). On still other occasions the argument is apparently based upon a contention concerning the meaning of the

regulations themselves (see Brief for Respondents, pp. 45–50, 53–54, 56, 60, 81).

We deal with these points seriatim.

1. The controlling regulation is Regulation 50.35, under which the Commission was proceeding because PRDC was not in a position to supply all the technical information required to complete the application. The pertinent sentence of Regulation 50.35 provides—

> * * * If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered.

After weighing the evidence on the safety of fast breeder reactors, the Commission found (Finding 18, R. 706)—

> (a) It has not been positively established that a fast breeder reactor [of the PRDC type] can be *operated* without a credible possibility of releasing significant quantities of fission products to the environment;
>
> (b) There is reasonable assurance that theoretical and experimental investigations * * * will establish definitively, prior to the sched-

uled completion date of the PRDC reactor, whether or not the reactor proposed by Applicant can be so operated;

(c) There is reasonable assurance that evidence will establish that the reactor proposed by Applicant can be so operated.

These three findings properly focus attention upon what the Commission did, and did not, find in the proceedings leading to the order continuing the PRDC construction permit. The Commission's safety standards are very high. In order to issue an operating license the Commission would have had to find that the PRDC fast breeder reactor, as finally designed, could be operated without a credible possibility of releasing significant quantities of fission products to the atmosphere. The Commission did not make this finding because the proof which further research and experimentation was expected to develop before the completion of the PRDC reactor was not available at the time of the hearing. The Commission did find that there was reasonable assurance that this proof would be available before the operation was licensed (Finding 21, R. 707; Finding 31, R. 710). Indeed, the Commission plainly announced that it would not issue an operating license unless the proof became available (Finding 37, R. 712; R. 676, 679–680, 718–719).

The Commission then went on to discuss the Lagoona Beach site and found that if the expected proof concerning the safety of the reactor became available, Lagoona Beach would be a safe location (Finding 21, R. 707–708).

The Commission then pulled these two groups of findings together into its final conclusion (Finding 22, R. 708)—

> The Commission finds reasonable assurance in the record, for the purposes of this provisional construction permit, that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public.

This finding follows the very words of Regulation 50.35 with two exceptions: (a) the parenthetical phrase "for the purposes of this provisional construction permit" is not in the regulation; and (b) the regulation does not include the specific reference to the PRDC Application.

(a) The phrase quoted above does not denigrate or qualify the finding that there was reasonable assurance that a reactor of the general type proposed could be constructed and operated at the location without undue risk to the public health and safety. The argument that the parenthetical phrase denigrates the finding ignores both the acknowledged issue before the Commission and the thrust and focus of its entire opinion and findings. Admittedly, the issue was properly framed in terms of Regulation 50.35 in the notice of hearing (R. 576, 578). The issue is also stated in those terms in a portion of the opinion rejecting respondents' legal arguments (R. 645–646). The facts are found in those terms in the opinion (R. 676–677). They are again stated in proper terms in

dealing, first, with the inherent safety of the reactor (R. 706), and, second, with its location (R. 707–708). But then, the respondents say, when the Commission pulled these admittedly proper findings together into the ultimate finding, it suddenly disregarded the regulation and its own prior findings, changed its meaning and, although it used the very language of Regulation 50.35, except for the parenthetical phrase, found something different than what the regulation contemplated.

This is patent nonsense. The phrase modifies the verb "finds." Respondents had been arguing to the Commission that it was prejudging the question whether a license to operate should issue. Respondents were also contending that the evidence would not support the kind of safety finding required for a license. By stating explicitly the limited purpose for which the finding was made the Commission preserved respondents' rights, warned PRDC, and reemphasized the limited character of the question before it.

(b) Respondents erroneously assert that we seek to distinguish between an initial finding of safety with respect to a reactor of the general type proposed and a finding of safety with respect to the operation of the proposed reactor and from this false premise they apparently argue that the Commission's findings are insufficient under Regulation 50.35 because the Act requires a finding as to the operating safety of the proposed reactor.

So far as compliance with the regulations is involved, the short answer is that Regulation 50.35 requires a safety finding concerning "a facility of the

general type proposed." The Commission made the finding with respect to "a utilization facility of the general type proposed in the PRDC Application" (R. 708). The correspondence is exact.

More fundamentally, the fallacy in respondents' argument is that it is a play upon words. In one sense the PRDC application related to a specific reactor—a reactor to be built at Lagoona Beach in accordance with certain specifications. In another sense every reference to the reactor described in the PRDC application covered only a general type because the details of the design had not been frozen and some had not even been tentatively described. So long as the final design remained open, a reference to the PRDC reactor would be specific in the sense that it referred to one identifiable project with certain specifications but it would describe only a class or type of reactor within the definition of which the final design would fall. Phrases like general type depend upon relative specificity and must be construed with reference to the subject matter.

The words "facility of the general type proposed" have been used in the foregoing sense in every Commission proceeding involving a major developmental reactor (see pp. 13–14, 49–61, *infra*). The phrases "facility of the general type proposed" and "final design" draw the contrast between the incomplete information available when an application may be filed and a construction permit is issued; and the minute specification of every detail which must be evaluated before issuing a license to operate. The description in an application for a reactor at a specific location de-

scribes only a general type of reactor so long as a number of final designs might be developed within the scope of the application. This process is still going forward in the PRDC proceeding.

The Commission has consistently granted provisional construction permits for developmental power reactors under Regulation 50.35 on the basis of findings of reasonable assurance of the operating safety of the general type of reactor proposed. In each of the eight other instances in which, up to the time of the decision here under review, the Commission has issued a provisional construction permit for a developmental power reactor, it did so upon the same findings it made here, namely, reasonable assurance that a reactor of the proposed type could be safely constructed and operated at the proposed site.[3] In none of them was the safety finding made in terms of the particular reactor to be constructed. In all of them, as in the instant case, the Commission provided, in accordance with Regulation 50.35, that operating authority would not be granted unless it found, upon completion of construction, that the final design provides reasonable assurance that public health and safety will not be endangered by operation. We have set out, in Appendix A, *infra*, pp. 49–61, excerpts from the construction permits and Commission deci-

[3] As we pointed out in our main brief (pp. 57–69), it is immaterial that in this case the Commission made the finding, "for the purposes of this provisional construction permit." That, however, is the sole basis upon which respondents attempt to distinguish the settled Commission practice (Resp. Br. 78–79).

sions in each of the other power reactor cases, which show that safety findings have uniformly been made in the terms of Section 50.35 and, in a majority of the cases (including this one), specific unresolved problems have been identified. In addition, there have been numerous other instances of non-power reactors (where the safety problems generally are not as difficult to solve as in developmental power facilities) in which the Commission, in authorizing construction, has expressly made findings with respect to a reactor of the general type proposed and has provided that an operating license would not issue until safety problems had been successfully resolved.[4]

Even if Regulation 50.35 were far less clear than it is, this settled administrative interpretation by the Commission of its own regulation would be entitled to "controlling weight." *Bowles* v. *Seminole Rock Co.*, 325 U.S. 410, 414.

Respondents point (Br. 53–56) to a proposed revision of Regulation 50.35, published for public comment in February 1960, which would have changed the standard for granting provisional construction permits to "reasonable assurance that the proposed location is suitable from a safety standpoint for a facility of the size (power level in the case of reactors) and general design concept proposed, that the applicant has identified any major features or components on which further research and development

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[4] *E.g.*, Westinghouse Electric Co. (Westinghouse Testing Reactor), CPTR-1, July 3, 1957; Georgia Institute of Technology, CPRR-57, June 13, 1960; University of Virginia, CPRR-15, September 13, 1957.

work is needed to determine their acceptability from a safety standpoint, and that the applicant will conduct a research and development program which will investigate the unresolved safety questions" (25 Fed. Reg. 1225). But that revision, which admittedly would have changed the standards presently embodied in Regulation 50.35, was never adopted; and its mere proposal casts no doubt upon the validity of the existing standards under which this permit was issued.

2. At a number of points respondents argue that the Commission's safety findings are insufficient because they relate only to the construction of the PRDC reactor (Brief for Respondents, pp. 57, 59, 72, 78, 80). The opinion and formal findings, however, discuss the safety of both construction *and operation* (R. 676–677, 706, 708). They are focused upon the safety of operation (R. 669–677, 706). A mere reading of the opinion and findings is enough to dispose of respondents' argument upon this point.

3. Respondents' remaining argument to the effect that the Commission's findings do not comply with its own regulations is based upon Regulation 50.40, which appears at pages 135–136 of our main brief. It is headed *"Common Standards"* and lists the "considerations" by which "the Commission will be guided" in determining whether a license should be issued: (a) the processes to be performed, the operating procedures and technical specifications provide reasonable assurance that the applicant will comply with the Commission's regulations and "that the health and safety of the public will not be endan-

gered"; (b) the applicant is technically and financially qualified to engage in the proposed activities, and (c) the issuance of the permit "will not * * * be inimical to the common defense and security or to the health and safety of the public." Respondents point to a passage in the opinion (R. 644) stating that at the construction permit stage of the proceeding these considerations were to be applied to what was being licensed—the construction—and then go on to argue that the Commission should have applied them to what was not then being licensed—actual operation. The argument has two fatal defects.

a. The Commission's opinion and findings, taken as a whole, show that the Commission did in fact guide itself by each of the considerations listed in Regulation 50.40, including the probable safety of operations. Section 50.40 does not require any specific finding about safety of operations at any specific stage in the proceedings leading to a license to operate. It leaves the Commission free to give such weight to the several considerations as it deems appropriate to the particular phase of the proceedings. Section 50.35 is the provision which specifies what findings shall be made, and when they shall be made, in a case involving a provisional construction permit. As shown above, the Commission's safety findings fully satisfy that section.

b. The Commission's interpretation of Regulation 50.40 is consistent with the words and supported by Commission practice. Regulations 50.35 and 50.40 are obviously intended to be consistent and Regulation 50.35, being the more specific, is the controlling pro-

vision with respect to construction permits. The general Section 50.40 covers licenses for different kinds of activities and the very concept of common standards means that the standards will be applied to the thing for which permission is sought—in this case the construction of a reactor.

This interpretation of Section 50.40 of the regulations is supported by the Commission's practice in other cases. We have set forth in Appendix B, *infra*, pp. 62–65, pertinent excerpts from the construction permits and Commission decisions for each of the nine other licensed power reactors showing the Commission's finding under Section 50.40. In none of them was any safety finding made in the terms of Section 50.40(a); in all of them the safety findings were made in terms of Section 50.35. Thus, the Commission obviously views Section 50.35, and not Section 50.40 (a), as governing the issuance of a provisional construction permit. The Commission deemed Section 50.40(b), relating to the applicant's technical and financial qualifications, applicable in all cases, although there are variations in the findings made thereunder. Some of the findings relate to qualification to construct and to operate, others only to construct. Seven of the permits (including the amended PRDC permit) are supported by findings under Section 50.40(c) that the issuance of the construction permit would not be inimical to the common defense and security and to the public health and safety; the remaining three did not make any finding thereunder. Each of the construction permits for these reactors was explicitly subject to the later production of omitted

technical information, yet to be evaluated by the Commission, showing that "the final design provides reasonable assurance that the health and safety of the public will not be endangered." For example, in granting the construction permit for the Yankee reactor at Rowe, Massachusetts, the Commission said—

> The construction permit must be provisional at this stage of the proceeding principally because Yankee has not completed the design of the reactor and certain features of the proposed facility present unresolved questions which might affect its safe operation. * * * [T]he experimental program outlined in the application will probably produce the information needed to resolve these questions prior to consideration of final design and operating procedures and conversion of the construction permit to a license.

For other illustrations see pp. 49–65, *infra*.

Respondents' assertion that a different procedure was followed in the PRDC case rests upon the use of the parenthetical phrase "for the purposes of this provisional construction permit" in Finding 22. As we have shown above, this phrase does not denigrate or qualify the finding (see pp. 10–11, *supra*). No one can conscientiously deny that the Commission has always followed the two-step procedure in the cases involving developmental power reactors, making a finding before it issued the provisional construction permit of the probability that a safe final design would be developed and reserving a decision upon the safety of the final design until the hearings upon the issuance of a license. A definitive finding on operating safety of the final design has been made at the

time of the construction permit issuance only in cases involving small reactors which are practically production-line items and as to which there are then no unresolved safety problems.

III

THE ATOMIC ENERGY ACT OF 1954 AUTHORIZES REGULATION 50.35 AND THE COMMISSION'S TWO-STEP LICENSING PROCEDURE

We turn now to the central issue—whether Regulation 50.35 ~~and the~~ two-step procedure followed by the Commission are authorized by the Atomic Energy Act of 1954. In our main brief, we showed that the regulation and practice are authorized by Section 104(b), which governs the issuance of licenses, and by the broad rule-making power granted by Section 161 to prescribe regulations necessary "to protect health or to minimize danger to life or property." We also showed that Section 185 foreshadows the two-step procedure.[5]

1. Respondents contend, however, that the substantive standard for the issuance of construction permits is contained in Section 182; and that this section requires the Commission, before authorizing construction, to make a definitive finding as to the operating safety of the proposed reactor. This argument is

[5] The second step of this procedure—the issuance of the operating license—itself may involve several steps. Thus, Regulation 50.57 (10 C.F.R. 50.57, Cum. Supp. 1961) authorizes the issuance of a provisional operating license where "it appears desirable to obtain actual or further operating experience before issuance of an operating license for the full term, up to forty (40) years, requested in the application."

fallacious in three respects: (a) Section 182 does not prescribe the substantive standards governing the granting of licenses, but only the content and form of license applications and related procedures. (b) The provisions of Section 182 upon which respondents rely apply only to operating licenses, and not to construction permits. (c) In any event, the Commission's findings in this case do satisfy the standards of Section 182, if applicable.

a. As pointed out in our main brief (pp. 38–39), the Commission's reactor licensing authority is contained in Sections 103 and 104, in the chapter of the Act entitled "Atomic Energy Licenses"; and it is those sections, rather than Sections 182 or 185, that define the substantive standards for licensing. The latter sections are in the chapter captioned "Judicial Review and Administrative Procedure." Section 182, captioned "License Applications," merely specifies what information all applications for a license must contain and in what form (182(a)), and sets out certain procedures to be followed. Section 185 provides for the issuance of construction permits, and indicates the circumstances in which, upon completion of construction, the Commission is to issue an operating license.

In the case of "applications for licenses to operate production or utilization facilities" (such as the PRDC reactor here involved), Section 182(a) states the requirements for the contents of applications in greater detail than for other licenses. It requires such applicant to submit specified technical material

and such other information as the Commission may deem necessary "to enable it to find that the utilization or production of special nuclear material * * * will provide adequate protection to the health and safety of the public." While this provision requires the furnishing of information upon which the Commission makes findings with respect to public health and safety, the Commission's duty to make such findings flows not from Section 182(a) but ~~from~~ the substantive provisions governing the issuance of licenses. It is to the latter provisions, therefore, that one must look to ascertain what findings the Commission must make and when it must make them. At the very most, the references to findings in Section 182(a) may throw light on the meaning of the provisions which deal with the issuance of licenses and permits; it cannot control them.

The standards for the licensing of all research and development reactor facilities, including authority both to construct and to operate, are contained in Section 104. Section 104(b) authorizes the Commission to issue licenses for developmental power reactor facilities, and provides that in "issuing licenses under this subsection" the Commission shall impose "such regulations and terms of license as will permit the Commission to fulfill its obligations * * * to protect the health and safety of the public." Section 104(d) prohibits the issuance of a license if, in the Commission's opinion, such issuance "would be inimical to * * * the health and safety of the public."

The statutory question in this case, therefore, is not, as respondents phrase it, whether Section 182 rather than Section 185 prescribes the standards for the issuance of construction permits, but whether the findings made by the Commission in the first step of its two-step licensing procedure satisfy the requirements of Section 104. We submit that they clearly do. Congress has given the Commission the broadest discretion to adopt what procedures it deems appropriate "to protect the health and safety of the public." The provisional construction permit system, allowing construction based on findings of reasonable assurance that the type of reactor proposed can be safely built and operated at the site and that remaining safety problems can be resolved, followed by a definitive safety determination before operation is authorized, fully achieves such protection. See our main brief, pp. 36–66.

b. If, contrary to our view, Section 182(a) should be read to prescribe substantive safety standards, still the standards would apply only to licenses to operate, not to licenses to construct. The first sentence of this section provides: "Each application for a license hereunder shall be in writing and shall specifically state such information as the Commission * * * may determine to be necessary to decide * * * qualifications of the applicant as the Commission may deem appropriate for the license." The second sentence, which is the only one referring to findings on public health and safety, provides that, "In connection with applications for *licenses to operate* production or utilization facilities, the applicant shall state * * *" (emphasis added), fol-

lowed by a specification of certain additional information to be furnished. Language could hardly be plainer to indicate that the requirements of the second sentence of Section 182 are applicable only to *licenses to operate* production or utilization facilities, and not to licenses to construct them. Had Congress intended the second sentence to be applicable to licenses to construct, it would either not have limited it to "licenses to operate," or else it would have specifically provided for such broader applicability—as it did in Section 185, which provides for construction permits for "applicants for licenses to construct or modify production or utilization facilities."

A further indication that the second sentence of Section 182 applies only to licenses to operate, and not to licenses to construct, is that it requires the submision of information to enable the Commission to find that "the utilization or production of special nuclear material" will provide adequate protection to public health and safety. "[U]tilization or production of special nuclear material" in a reactor takes place in connection with its operation, not its construction.

Respondents argue (Br. 36), however, that the second sentence of Section 182 must apply to construction permits because the last sentence of Section 185 states that "[f]or all other purposes of this Act, a construction permit is deemed to be a 'license.'" There are two answers:

First, many of the provisions of the Act apply to licenses generally. Other provisions apply to specific

kinds of licenses. The broadest effect which the last sentence of Section 185 can sensibly be given is to make a construction permit the equivalent of a license for the purpose of those provisions which are applicable to licenses generally (*e.g.*, Section 103, 104, 105, 182(b), 182(c), 182(d), 184, 186, 189). Plainly, the sentence does not make the permit the equivalent of any particular kind of license, or of every particular kind of license. And since the second sentence of Section 182(a) applies only to licenses to operate, it is not applicable to licenses generally, and therefore not applicable to a construction permit.

Second, respondents' argument ignores the fact that a construction permit is made the equivalent of a license only "[f]or *all other* purposes of this Act." (Emphasis added.) This must mean purposes other than those of Section 185. It follows that the construction permit is not a license for the purpose of determining whether Section 185 incorporates by reference any substantive standards contained in Section 182 or authorizes the Commission to issue a permit with less complete information than Section 182 would require for the purpose of issuing an operating license. Obviously, Section 185 answers this question by stipulating that the Commission may proceed to issue a permit in the absence of the complete information.

Respondents stress (Br. 33-34) that Section 185 merely provides that, upon completion of construction pursuant to the permit and the satisfaction of certain conditions, the Commission shall issue a "license," but does not specify that it be a license "to

operate." But, in the context of this case, it could be nothing else. In other situations, the license to be issued upon completion of construction may be a license to sell, to transfer, or to export. The significant fact is that Section 185 distinguishes between the initial stage of construction pursuant to a construction permit, and the subsequent stage of operation, sale, transfer or export pursuant to a second, and different, license. It thus supports the Commission's regulation (§ 50.35) providing for different safety findings at the two stages of licensing. See our main brief, pp. 49–52.

Respondents also point out (Br. 31–32) that the second sentence of Section 182(a) specifies, among the information to be furnished in connection with applications for operating licenses, "the place of the use," and that this information ordinarily is needed to describe the facility to be constructed. From this they argue that the second sentence of Section 182 covers licenses to construct. But the fact that information which the statute requires to be submitted in an application for an operating license may also be useful in connection with a construction permit does not establish that a statutory requirement which is limited in terms to "licenses to operate" should be construed to apply to construction permits, and there is nothing inconsistent in the Commission's requiring the same information to be supplied in an application for a construction permit as the statute requires for an operating license.

This conclusion is borne out by the Commission's regulations governing the submission of information

in license applications. The Commission has implemented Section 182(a) by prescribing, in Regulation 50.34, the detailed technical information pertinent to health and safety that must be included in all applications for reactor licenses. If the nature of the proposed reactor is such that complete information can be submitted at the construction permit stage (as is true today for many research reactors), then the applicant can obtain a nonprovisional permit, *i.e.*, the Commission makes the definitive safety findings when it authorizes construction. In such a case, an operating license will ordinarily be issued upon completion of construction merely upon a showing that the construction has been carried out in accordance with the permit.

Where, however, "because of the nature of a proposed project, an applicant is not in a position to supply initially [*i.e.*, in the application for the construction permit] all of the technical information otherwise required" by Section 50.34 for a definitive safety determination, Regulation 50.35 provides for the issuance of a construction permit "on a provisional basis" upon findings of reasonable assurance (1) that a "facility of the general type proposed" can be safely constructed and operated at the proposed site, and (2) that "the omitted information will be supplied" (that is, that the applicant will be able to establish, prior to operation, the safety of the final design).

Thus, the Commission's regulations provide for the submission of the maximum available safety information in an application for a construction permit, and

authorize the granting of a provisional construction permit only where, "because of the nature of a proposed project," all information necessary for a definitive safety determination cannot be then supplied.

c. In any event, if Section 182(a) does provide standards governing the issuance of construction permits, we submit that the Commission's safety findings in this case met those standards.

Section 182(a) merely requires the submission of such information as the Commission may require "to find that the utilization or production of special nuclear material will * * * provide adequate protection to the health and safety of the public." Here the Commission's ultimate finding that a reactor of the general type proposed in the PRDC application can be safely constructed and operated at the location without undue risk to public health and safety (Fdg. 22, R. 708) rested on subsidiary findings of reasonable assurance that, prior to authorizing operation, it can be established that "the proposed reactor" is inherently safe and that "no credible accident can release significant quantities of fission products into the atmosphere" (Fdgs. 21, 18, R. 707–708, 706). In other words, the Commission found reasonable assurance that it will be demonstrated that this reactor can be safely operated.

These subsidiary findings would not have been sufficient to authorize operation, since various health and safety problems still remain to be resolved. But a finding of *future* safe operation, made at the time construction is authorized and several years prior to operation, may be based upon less complete and

definite information than the definitive safety evaluation to be made at the time that operation is authorized. As the Commission stated (R. 679, emphasis in original), "The degree of 'reasonable assurance' with respect to safety that satisfies us in this case for purposes of the provisional construction permit would not be the same as we would require in considering the issuance of the *operating* license."

The Commission thus here found, in substance, that "the utilization * * * of special nuclear material" (in the operation of the reactor) "will provide adequate protection to the health and safety of the public," since it found (Fdg. 18, R. 706, emphasis in original) reasonable assurance that it will be demonstrated "that the reactor proposed by Applicant" "can be *operated* without a credible possibility of releasing significant quantities of fission products [in]to the environment." And the Commission has explicitly provided in the construction permit that it will not grant an operating license unless it "has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the specified procedures" (R. 718; see, also, R. 679–680, 712).

2. We showed in our main brief (pp. 37, 39–52) that Section 185 sanctions the Commission's settled practice, pursuant to its regulations, of granting a provisional construction permit on findings of reasonable assurance of safe operation of the particular type of reactor proposed, subject to a definitive safety determination after construction and preliminary

testing is completed but before an operating license is issued. We pointed out (*ibid*) that Section 185 provides (1) that a construction permit is to be granted "if the application is otherwise acceptable to the Commission,"[6] and (2) that (a) upon completion of construction, (b) the filing of any additional information needed to bring the original application up to date, (c) upon finding that the facility has been constructed "and will operate" in conformity with the amended application "and in conformity with the provisions of this Act and of the rules and regulations of the Commission," and (d) in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the Act, the Commis-

[6] Respondents distort our position when they state (Br. 35) that we construe Section 185 as providing "no statutory safety standards for, and no limit on the Commission's discretion in regard to, the issuance of construction permits." Our point is that the broad language in Section 185 governing the issuance of construction permits leaves it to the Commission's discretion to select an appropriate method for meeting the basic statutory standard in Section 104 that all licenses must provide adequate protection to public health and safety. In Regulation 50.35 the Commission has provided that an applicant for construction authority, who is unable initially to supply all the technical information necessary for a definitive safety evaluation (as in this case), may be granted a construction permit upon a provisional basis. But such authority is issued only upon finding reasonable assurance that a facility of the proposed type can be safely built and operated, and that the information necessary for an ultimate finding of operating safety of the particular reactor will be supplied. This procedure fully satisfies the standards of Section 104 of adequately protecting the public health and safety. See our main brief, pp. 42-52.

sion shall issue a license. We concluded (Br. 50) that the latter two criteria—operation in conformity with the Act and the rules and regulations, and the "good cause" requirement—were intended to assure that the statutory criteria for safe operation would be met before an operating license is issued.

Respondents contend (Br. 36–39), however, that the "good cause" provision gives the Commission the right to refuse an operating license for safety reasons only if "some objector" raises the issue, and that the third requirement (construction and operation in accordance with the Act and rules and regulations) requires only a finding "that the *terms of the construction permit have been carried out*" (Br. 37, emphasis in original). Since one of the "terms" of every provisional construction permit, including this one (R. 718–719), is that all unresolved safety problems be satisfactorily resolved, respondents' argument falls of its own weight. Furthermore, the requirement of completion of construction in accordance with the permit is only one of two standards in the third condition. The Act requires the Commission to find that the facility has been constructed and will operate not only in conformity with the application, but also "in conformity with the provisions of this Act and of the [Commission's] rules and regulations." Operation in conformity with the Act necessarily means operation consistent with the public health and safety protection standards that the Act contains. Thus, Section 185 requires the Commission, before granting an operating license, to find not only that the construction permit has been com-

plied with, but also that operation of the reactor as built will not be "inimical to * * * the health and safety of the public" (Section 104(d)). The good cause provision further confirms the view that the Commission, before granting an operating license, must find that operation will be safe, since it permits other persons (including members of the Commission's staff or intervenors such as respondents) to bring to the Commission's attention any adverse facts bearing upon operating safety.

In this case, the Commission explicitly stated in the amended construction permit that an operating license will not be issued "unless * * * the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the specified procedures" (R. 718); and that, upon completion of construction in accordance with the permit, an operating license will issue only "upon a further finding, after conclusion of additional proceedings, if they be necessary or appropriate, of reasonable assurance of safety of operation" (R. 719). See also Finding 37, which states (R. 712, emphasis in original):

> Proceedings for a license to *operate* the proposed PRDC plant shall be held at a time later to be determined, after the completion of construction. In that proceeding the safety and financial considerations of the PRDC project will be in issue, and we shall again consider whether the PRDC plant can be *operated* with reasonable assurance for the protection of the health and safety of the public.

In short, the Commission has made it explicit that it will not grant an operating license for the PRDC reactor unless it finds that the reactor can be operated safely. As the Commission emphasized in its opinion (R. 646–647, emphasis added): "There can be no doubt that public safety is the first, last, and a permanent consideration in any decision on the issuance of a construction permit *or a license to operate a nuclear facility.*" Section 185 plainly authorizes the Commission to refuse an operating license unless it finds that the reactor can be safely operated, even if construction has been done in full accord with the design presented at the construction permit stage; and Regulation 50.35 provides for a definitive safety determination prior to the grant of an operating license whenever a construction permit is issued on a provisional basis.

The Commission's provisional construction permit procedure, based upon a finding of operating safety of the general type of reactor proposed when construction is authorized, subject to a further definitive safety evaluation of the proposed final reactor design before operation is permitted, provides much greater protection to the public health and safety than respondents' suggestion that all definitive safety findings should be made when the construction permit is issued since the Commission must issue an operating license as long as construction is carried out in accordance with the permit. For under the Commission's two-step procedure the Commission makes its final definitive safety determination on the basis of the latest scientific knowledge and experience

available, including that developed during the construction period. Respondents, however, would require the Commission to base its determination of ultimate operating safety upon information available when construction is first authorized, which may be several years before operation begins. We submit that the strong Congressional concern for safety repeatedly manifested in the Act is clearly furthered by the Commission's settled practice.

3. Neither of the two items of legislative history that respondents cite (Br. 39–44) supports their argument that Section 182 applies to construction permits.

a. The first item—a colloquy between Senator Humphrey and Senator Hickenlooper during which the latter stated that a license and construction permit are equivalent—did not relate to safety matters at all, but to whether the various procedures (such as notice, appellate review and licensing preferences) applicable to the issuance of operating licenses would also be applicable to the issuance of construction permits. See our main brief, pp. 57–61. The proposed amendment of Senator Humphrey, which he subsequently withdrew upon being informed that amendments already made to the bill covered the problem, was that "no construction permits shall be issued by the Commission until after the completion of *the procedures established by section 182* for the consideration of applications for licenses under this act" (100 Cong. Rec. 12014, 3 Leg. Hist. 3759, emphasis added).

The "procedures" of Section 182 to which this proposed amendment related were the giving of notice of license applications and the grant to various public bodies of preferred consideration in licensing, not any "procedures" with respect to the kind of safety findings the Commission must make in issuing construction permits. This is shown not only by the legislative history cited in our main brief, but by the following italicized statement that was omitted from respondents' quotation (Br. 42) from the Senate debate (100 Cong. Rec. 12014, 3 Leg. Hist. 3759):

> Mr. HUMPHREY. * * *
>
> In other words, as I understand, under the bill a construction permit cannot be interpreted in any other way than being equal to or a part of the licensing procedure. Is that correct?
>
> Mr. HICKENLOOPER. The Senator is correct. The staff has worked on this matter. An amendment was offered on, I believe, July 16, to section 189, having to do with hearings or judicial review, and that section was tied up with other sections of the bill. A license and a construction permit are equivalent. They are the same thing, and one cannot operate until the other is granted.
>
> The same is true with reference to hearings. Therefore, we believe, and we assure the Senator, that the amendment is not essential to the problem which he is attempting to reach.
>
> Mr. HUMPHREY. *Let me ask the chairman of the committee if subsection b of section 182, which applies to license applications, also applies to construction permits? Subsection b reads:*

b. The Commission shall not issue any license for a utilization or production facility for the generation of commercial power under section 103, until it has given notice in writing to such regulatory agency as may have jurisdiction over the rates and services of the proposed activity, and until it has published notice of such application once each week for 4 consecutive weeks in the Federal Register, and until 4 weeks after the last notice.

Mr. HICKENLOOPER. *The section does. The answer to the Senator's question is "Yes".*

Mr. HUMPHREY. In other words, the revised sections on judicial review and on hearings and the revised section 182 on license application all apply directly to construction permits?

Mr. HICKENLOOPER. Yes.

Mr. HUMPHREY. With that statement, Mr. President, I withdraw my amendment. The only purpose of the amendment was to clarify that section. I am grateful to the chairman for having done it before the amendment was considered.

The notice requirement referred to in the foregoing italicized statement (now in Section 182(c)) was one of the procedural revisions designed to give greater rights for public bodies which Senator Humphrey and other opponents of the draft bill were able to obtain on the floor of the Senate. It—like the rest of the statements during the debate upon which Respondents rely—had no reference to safety findings, and it affords no support for respondent's conclusion that Congress, by making the procedural provisions of Section 182 and Section 189 applicable to

construction permits, also made applicable the operating safety findings referred to in Section 182.

b. The second item cited (Br. 39–40) is a colloquy from hearings in 1954 involving the testimony of an industry witness, Mr. McQuillen. It appears that Mr. McQuillen was concerned (1) with the administrative burden on an applicant where his proposed activities would, under the bill, require allegedly up to nine different licenses and (2) with what he viewed as the failure of the bill to provide that licensees "would have the assurance that when they had the facility finished in accordance with each of their requirements they would be able to run it." Chairman Cole's comment, cited by respondents, that "undoubtedly" the bill as drawn "would be so operated" does not seem, as respondents contend, to have been directed to the second point, but rather to the first.[7]

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[7] Respondents reach their conclusion by omitting to quote that portion of the colloquy which, because it immediately precedes Chairman Cole's interjection, was apparently the statement to which he was directing his attention. This was a statement by Representative Hinshaw:

> Representative HINSHAW. *That seems to me to be reasonable, that you should put all the conditions into 1 license that can be put into 1 license. That would be fair enough.*
>
> Chairman COLE. Would you mind my interruption? Why cannot that be done under the terms of the bill as it is now?
>
> Mr. MCQUILLEN. I think it undoubtedly would be so operated.
>
> Chairman COLE. Of course it would.

[Hearings Before the Joint Committee on Atomic Energy on S. 3323 and H.R. 8862, 83d Cong., 2d Sess., p. 119, 2 Leg. Hist. 1753.]

The problem particularly referred to by Representative Hinshaw was subsequently cleared up by a committee amendment which added Section 161(h) to the bill, authorizing the Com-

In any event, even if the comment had been directed to the second point, the conclusion respondents draw would not follow. The next statement of the witness, in response to Representative Cole's statement, was: "But the terms of the construction-permit section would need a little amendment, I think, to make construction and license at the end of that upon construction as required fit together" (Hearings, fn. 7, *supra*). In other words, the industry witness himself recognized that Section 185 as drafted would not automatically insure an operating license merely because construction was carried out in accordance with the terms of the permit.

4. Respondents challenge (Br. 58–64) our argument (Main Br. 62–66) that Congress has acquiesced in the Commission's two-step provisional construction permit procedure, on the ground that the Commission allegedly never informed Congress that it grants such permits upon finding reasonable assurance of safe operation of the general type of reactor proposed, and defers a definitive safety finding of the final design until the reactor has been construed and is to be licensed to operate. The argument takes various forms. Thus, they contend (Br. 59) that the Commission never informed Congress that its regulations on construction permits require only "a finding that construction would not endanger public health and

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mission to "consider in a single application one or more of the activities for which a license is required by this Act" and to "combine in a single license one or more of such activities". Compare S. 3323, 1 Leg. Hist. 181, 234, with S. 3690, 1 Leg. Hist. 645, 718.

safety. The Commission has never taken that view. It did not take that view in the present case. Here, as in all other provisional construction permit cases, the Commission acted on the basis of findings of reasonable assurance that a reactor of the proposed type could be safely constructed *and operated* at the proposed site (R. 676–77, 706, 708).

Respondents also contend (Br. 60) that the Commission in this case departed from its practice in other provisional construction permit cases (of which Congress was aware), because here the safety findings were made "for the purposes of this provisional construction permit." The argument is entitled to no more weight in this context than it is elsewhere (see *supra*, pp. 10–11, 18, and our main brief, pp. 67–69). Respondents also refer (Br. 60–64) to Congressional criticism of the issuance of the original PRDC permit in 1956. That point, however, has no relevance to the issue before this Court: the validity of the amended permit issued in 1959. See *supra*, pp. 3–7. And it was the procedure followed in issuing such amended permit that the Commission brought to the attention of Congress.

If, despite the material set forth in our main brief (pp. 62–66), there were any doubt as to whether the Commission had informed Congress as to the basis upon which it issues provisional construction permits, such doubt is dispelled by the very Commission statement that respondents quote at page 60 of their brief. The Commission there advised the Joint Committee that—

> The Commission staff reviews these reports as they are submitted, holds informal meetings

with the applicant, discusses the safety aspects of the reactor with its advisers (ACRS), considers the progress of the developmental programs which are being carried out by the applicant, and *finally arrives at a point when it believes that there is reasonable assurance that the unresolved safety problems can be resolved* in a way that will make it possible for the applicant to operate the proposed reactor at the proposed site without undue risk to the health, safety, and property of the public. *At this juncture,* the Commission may issue a conditional construction permit. [Emphasis added]

If respondents' claim is that the Commission's reporting to Congress was insufficient to show acquiescence by the latter because the Commission never specifically used the precise terminology of Regulation 50.35 ("a facility of the general type proposed"), the short answer is that it did. On May 15, 1956, the then general manager of the Commission advised the Joint Committee (Hearings Before the Joint Committee on Atomic Energy on Governmental Indemnity for Private Licensees and AEC Contractors against Reactor Hazards, 84th Cong., 2d Sess., pp. 62–63, emphasis added):

> * * * We have established procedures whereby the applicant may submit the results of his hazard evaluation step by step as a series of preliminary hazard summary reports. At such a time as we are satisfied that we have *information sufficient to provide reasonable assurance that a facility of the general type pro-*

posed can be constructed and operated at a proposed location without undue risk to the health and safety of the public, we can issue a construction permit for the facility. Such a permit is, of course, conditional and will not convert to a license to operate until the complete hazard summary report has been submitted, and we have made a finding based thereon that the final design of the specific facility provides reasonable assurance that the health and safety of the public will not be endangered by operation of the reactor in accordance with specified procedures.

This is the type of construction permit that we will probably have to issue for all of the power demonstration reactors, and even for many of the research, testing, and medical reactors, for the next few years.

The foregoing statement is an exact description of the procedure followed by the Commission in this very case.

The two Joint Committee staff studies of the Commission's regulatory program have similarly shown full knowledge of the basis upon which the Commission issues provisional construction permits. Joint Committee on Atomic Energy, *A Study of AEC Procedures and Organization in the Licensing of Reactor Facilities,* 85th Cong., 1st Sess. (Joint Committee Print 1957), pp. 6, 96, 107–108; Joint Committee on Atomic Energy, *Improving the AEC Regulatory Process,* 87th Cong., 1st Sess. (Joint Committee Print 1961), Vol. 1, p. 31, Vol. 2, p. 154. Moreover, the Commission sends copies of all construction permits and its decisions thereon to the Joint Committee.

IV

RESPONDENTS' ASSERTIONS AS TO THE SAFETY HAZARDS OF ATOMIC REACTORS GENERALLY AND OF THE PRDC REACTOR IN PARTICULAR ARE CONTRARY TO THE FACTS

Respondents make numerous unsupported and unwarranted statements with respect to the operating safety hazards of atomic reactors generally and the PRDC reactor in particular. For example, after noting the government's statement in its brief that there had been only one fatal reactor accident in this country, on January 3, 1961, they state (Br. 15) that "many reactor accidents have occurred, some causing serious injuries to reactor personnel and undetermined injuries to the surrounding population." In support of this statement, they cite a four-page "List of Reported Atomic Reactor Accidents" contained in the appendix to their brief, pp. 105–108). We have set forth in Appendix C, *infra*, pp. 66–91, a detailed description and explanation of each of the alleged "accidents" in the United States, and of those elsewhere for which information is available, prepared by the Commission's Division of Licensing and Regulation.

This material shows that, contrary to respondents' statement, reactors have indeed been operated in the United States with a "remarkable safety record" (R. 879). Of the 22 "accidents" in this country cited by respondents, only one (to which we previously referred) involved any fatalities, and that one resulted in the death of three operators inside the reactor building. Three resulted in overexposure of

operating employees to radiation, with no reported injuries. Several others caused a temporary increase in radiation levels in the facilities which, however, did not result in overexposure of any persons.[8] The remaining 13 "accidents" involved only various difficulties in operation, ranging from corrosion of a component, requiring replacement, to damage to the reactor. While these may have necessitated cleanup and maintenance work, they did not present hazard to operating personnel or to the public. None of the incidents involved any person not employed in the reactor itself.

We recognize, of course, that an atomic reactor accident, if it should occur, might cause serious public injury. But it is precisely because of this danger that such extraordinary safety precautions are taken in this industry. The Commission's elaborate health and safety program is based upon a full recognition of the dangers and, also, of the means available to prevent any injurious consequences. Atomic reactors may yet be a mystery to the average layman. But there is a wealth of scientific information which teaches that this new source of controlled energy can be, and

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[8] Part 20 of the Commission's regulations prescribes the applicable radiation exposure limits—permissible radiation levels and concentrations of radioactive material for persons in restricted areas, *i.e.*, employees in atomic energy facilities, and for unrestricted areas accessible to the public. These limits, based in part upon long-term experience with X-rays and radium, provide substantial margins of safety to permit continuous exposure without deleterious effects. The Commission's regulations conform to the Recommendations of the National Committee on Radiation Protection, National Bureau of Standards Handbooks 59 (1954, Supp. 1958), 69 (1959).

is being, safely utilized for beneficial ends. Statistics show, as one well-known commentator in the atomic energy field (Professor Estep of the University of Michigan Law School) recently stated (Estep, *Radiation Injuries and Statistics: The Need for a New Approach to Injury Litigation*, 59 Mich. L. Rev. 259, 260) that:

> An amazing safety record has been achieved by the nuclear industry so far and enough is known about radiation safety to support an argument that it is safer to handle radiation than many other types of material which industrialized countries have been using for decades. * * *.

While accident statistics are not available for those engaged in the operation of atomic reactors as such, the Commission has statistics showing the accident rate in its own installations. For the year 1960, this was 1.68 disabling injuries per million man-hours worked. This is far below the National Safety Council's industry-wide average for 1959 (the latest figures available) of 6.47 injuries per million man-hours worked. Only one industry reported by the National Safety Council had a lower rate than the Commission's installations: communications, with .96 injuries. The Commission's accident rate is lower than that in such industries as aircraft manufacturing (2.01), chemicals (3.32), textiles (4.34), printing and publishing (5.52), tobacco (6.50), pulp and paper (7.44), meat packing (8.20), and air transport (15.33). In terms of days lost per million man-hours worked, the Commission's 1960 record of 198 is far below the

industry-wide average of 754, and is bettered by only four industries (communications, wholesale and retail trade, electrical equipment, and storage and warehousing). Accident Facts, 1960 edition, published by the National Safety Council, Chicago, Ill., p. 26; AEC Press Release D-72, March 30, 1961.

Sir John Cockroft, a prominent British physicist to whose statements respondents refer (Br. 7, n. 7),[9] recently stated that the working force of more than 30,000 persons in Great Britain's atomic power industry has suffered no ill effects from radiation. New York Times, April 7, 1961, p. 12.

With respect to the safety hazards of this particular reactor, respondents, citing a recent motion filed by PRDC with the Commission requesting an extension of time for completion of construction, state (Br. 9) that PRDC has not yet solved its bowing problem, *i.e.*, the danger that fuel elements may bend toward each other, causing nuclear instabilities. That motion itself, however, and other public documents filed by PRDC, indicate that it believes that the bowing problem has been solved.[10] Moreover, the experiments that

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[9] Respondents refer (Br. 7, n. 7) to a statement by Sir John that an accident in Britain's Windscale reactor in 1957 released more radio-activity than is released during an explosion of an atomic bomb of the Hiroshima type. In the Windscale accident, a release and dispersal of fission products into the atmosphere resulted not from an explosion, but from a fire in the graphite moderator (which PRDC will not have) and from the absence of gas-tight containment (which PRDC will have). There were no reported injuries from the Windscale accident. See *infra*, pp. 83–84.

[10] PRDC's Eighth Quarterly Technical Report, dated September 10, 1960; PRDC Application for Extension of Construction Permit, dated October 28, 1960.

have been conducted since the decision in this case at the Commission's Experimental Breeder Reactor No. 1 have apparently confirmed that the problem is soluble, as the Commission anticipated (R. 672, 704).[11] In any event, the Commission has made it clear that PRDC will not receive a license to operate until it has demonstrated that the bowing problem has been solved (R. 676, 712, 718–719).

Respondents also refer (Br. 8, n. 8) to a recent statement in a periodical that the "maximum credible accident" for the PRDC reactor has not been defined. The Commission stated in this case that it requires applicants to identify the worst accident deemed credible, so that the Commission can evaluate it and determine "whether the worst accident deemed credible can have hazardous consequences to the public," and that PRDC had not yet done so (R. 678–679). The Commission made it explicit, however, that it would not issue an operating license until this evaluation had been made and it is shown that the reactor can be safely operated. While the maximum "credible accident" may not have yet been determined, this does not mean that there are no known limits to a possible accident in the PRDC reactor. Indeed, Dr. Bethe discussed "incredible accidents" and the safeguards against them (R. 765–767).

[11] Argonne National Laboratory Summary Status of Fast Breeder Reactor Program, dated December 1, 1960. This technical report, filed by the AEC Staff, and the PRDC report cited in the preceding footnote, have been incorporated in the public record of this proceeding and served upon all parties, pursuant to Commission Order (R. 711–714).

V

THE COMMISSION'S FINDINGS ON THE SAFETY OF THE SITE ARE ADEQUATE

Respondents make no attempt to defend the ruling below (R. 964) that "the Commission's safety findings are deficient in an additional respect," namely, that although "Congress intended no reactor should, without compelling reasons, be located where it will expose so large a population to the possibility of a nuclear disaster * * *, [i]t does not appear that the Commission found compelling reasons or saw that such reasons were necessary." Instead, they argue (Br. 87) that all the court really meant was that "the most compelling reasons are not a substitute for sufficient safety findings concerning the reactor itself." [12] Their discussion of this issue is primarily an attack upon the sufficiency of the Commission's findings as to the safety of this particular site.

Respondents contend that the Commission did not "relate * * * the site problem to population density" (Br. 83). Finding 19 (R. 707), however, expressly states the population distribution within various distances from the site, ranging from one to thirty miles, and recognizes that during the summer months the population within five miles would be increased due to vacationing transients and people visiting beaches. The Commission's ultimate finding (R. 708) of reasonable assurance that a reactor of this type can be constructed and operated "at the location",

[12] Respondents' further contention (Br. 87) that the ruling is dictum is refuted by the opinion itself.

without undue risk to public health and safety was thus made in the light of the population density in the area. There is no basis for respondents' contention (Br. 85) that the Commission "actually rejected" "population density" in making its safety findings, merely because it did not repeat the language of the finding in the initial decision that referred to "the population density around the site" (R. 614).

Respondents also refer (Br. 88–90) to the Commission's proposed regulations on Reactor Site Criteria, published on February 11, 1961, 26 F.R. 1224, and suggest that the Commission has "belatedly" changed its policy to consider population densities near reactor sites. On the contrary, as the Commission explained in recent Congressional hearings, and as the regulations themselves indicate, the published criteria do not represent a departure from prior practice, but are a publication and crystallization of the criteria which the Commission has regularly applied to reactor location. Hearings on Development, Growth, and State of the Atomic Energy Industry, before the Joint Committee on Atomic Energy, 87th Cong., 1st Sess., p. 103 (stenographic transcript).

Indeed, respondents themselves concede (Br. 89) that the location of the PRDC reactor would be acceptable under the published criteria. This can be shown from the proposed regulations. Sample figures are presented for appropriate distances from population centers, given according to reactor power level, which can be utilized as an "initial estimate" for a particular reactor. (10 C.F.R. 100.11(b), 26 F.R. 1225.) The figures vary from 0.7 miles for a reactor

of 10 thermal megawatts, 6 miles for a reactor of 300 thermal megawatts (the size of PRDC), and up to 17.7 miles for a reactor of 1500 thermal megawatts. The PRDC reactor, however, will be located 25 miles from Toledo and 30 miles from Detroit. Even under the Commission's qualifications that distances may have to be greater from very large cities, and for reactors with novel design features (which respondents stress), there is no reason to doubt that the PRDC site is well within the proposed standards.

CONCLUSION

For the foregoing reasons, and for those set forth in our main brief, the judgment of the court of appeals should be reversed.

Respectfully submitted.

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APRIL 1961.

APPENDIX A

EXCERPTS FROM CONSTRUCTION PERMITS ISSUED FOR POWER REACTORS AND ACCOMPANYING COMMISSION DECISIONS RELATED TO SAFETY FINDINGS UNDER SECTION 50.35 OF THE COMMISSION'S REGULATIONS

1. *Consolidated Edison Company of New York, Inc.*, Construction Permit No. CPPR–1 issued May 4, 1956:

"The Atomic Energy Commission (hereinafter the 'Commission') has found that: * * *

"E. Consolidated has submitted sufficient information to provide reasonable assurance that a utilization facility of the general type proposed by Consolidated can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that additional information required to complete its application will be supplied.

* * * * *

"(4) This permit is subject to submittal by Consolidated to the Commission (by proposed amendment of the application) of the complete, final Hazards Summary Report (~~portions of which~~ may be submitted and evaluated from time to time) and a finding by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the reactor in accordance with the specified procedures."

2. *Commonwealth Edison Company*, Construction Permit No. CPPR–2, issued May 4, 1956:

"The Atomic Energy Commission (hereinafter the 'Commission') has found that: * * *

"(E) Commonwealth has submitted sufficient information to provide reasonable assurance that a utilization facility of the general type proposed by Commonwealth can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that additional information required to complete its application will be supplied.

* * * * *

"(4) This permit is subject to submittal by Commonwealth to the Commission (by proposed amendment of the application) of the complete, final Hazards Summary Report (portions of which may be submitted and evaluated from time to time) and a finding by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the reactor in accordance with the specified procedures."

3. *General Electric Company*, Construction Permit No. CPPR-3, issued May 14, 1956:

"The Atomic Energy Commission (hereinafter the 'Commission') has found that: * * *

"E. GE has submitted sufficient information to provide reasonable assurance that a utilization facility of the general type proposed by GE can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that additional information required to complete its application will be supplied.

* * * * *

"(4) This permit is subject to submittal by GE to the Commission (by proposed amendment of the application) of the complete, final Hazards Summary Report (portions of which may be submitted and

evaluated from time to time) and a finding by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the reactor in accordance with the specified procedures."

4. *Power Reactor Development Company*, Construction Permit No. CPPR–4, as amended, is set forth at R. 715, the Commission's decision at R. 630.

5. *Yankee Atomic Electric Company*, Construction Permit No. CPPR–5, issued November 4, 1957:

"E. The applicant may proceed to design and construct the proposed reactor without further authorization in accordance with the application and amendments thereto. However, this does not constitute final approval of any technical specification of the reactor. Before the license is issued to operate the facility, the Commission must finally approve all technical specifications. If the applicant desires final approval of any particular technical specification prior to the issuance of the license to operate, he may request that the Commission grant specific approval of any technical specification by appropriate amendment to this permit.

"This permit is provisional to the extent that a license authorizing operation of the reactor will not be issued by the Commission unless Yankee has submitted to the Commission (by proposed amendment to the application) the complete, final Hazards Summary Report (portions of which may be submitted and evaluated from time to time) and the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the reactor in accordance with the specified procedures."

The Commission's Order dated October 31, 1957, directing issuance of the permit, stated:

"It Is Found That: * * *

"D. There is sufficient information to provide reasonable assurance that a reactor of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public; and that additional information required to complete the application will be supplied.

"The Commission believes that the applicant has identified the subjects which should be further investigated and that the plans described for carrying out these investigations will produce the information which will be needed prior to consideration of final design and operating procedures and conversion of this construction permit to a license."

The Commission's accompanying Memorandum of Opinion stated:

"The reactor will be a pressurized water reactor generally similar to the pressurized water reactor (PWR) now nearing completion at Shippingport, Pennsylvania. Considerable information and experience have been acquired from the design and operation of pressurized water reactors by the Commission and the Department of Defense. Additional information and experience will be gained from continued operation of these reactors, and from the design and operation of other pressurized water reactors, prior to completion of the Yankee reactor. The accumulated experience and information now available as to such reactors, together with the information contained in the application, warrant the conclusion that there is at the present time reasonable assurance that a facility of the type proposed by Yankee can be constructed and operated at the proposed location without undue risk to the health and safety of the public. Accordingly, we have decided to authorize issuance of a construction permit to Yankee on a provisional basis pursuant to Section 50.35 of our regulations.

"The construction permit must be provisional at this stage of the proceeding principally because Yankee has not completed the design of the reactor and certain features of the proposed facility present unresolved questions which might affect its safe operation. These features have been identified and discussed in the testimony furnished at the hearing by Dr. Clifford K. Beck, Chief of the Hazards Evaluation Branch and in the report of the Advisory Committee on Reactor Safeguards.* We agree with Dr. Beck and the Advisory Committee that the experimental program outlined in the application will probably produce the information needed to resolve these questions prior to consideration of final design and operating procedures and conversion of the construction permit to a license."

6. *Saxton Nuclear Experimental Corporation,* Construction Permit No. CPPR-6, issued February 11, 1960:

"1. * * * D. The applicant may proceed to design and construct the facility described in the application and amendments thereto without further authorization. However, this does not constitute final approval of any technical specification of the facility as distinguished from the general design concept proposed. Before the license is issued to operate the facility, the Commission must finally approve all technical specifications. If the applicant desires final approval of any particular technical specification prior to the issuance of the license to operate, he may request that the Commission grant specific approval of any tech-

* "As identified in the testimony of Dr. Beck and in the report of the Advisory Committee on Reactor Safeguards, these questions include:

"1. The addition of neutron absorbers;

"2. Intentional design into the reactor of nucleate boiling; and

"3. Large plutonium build-up." (Commission's footnote.)

nical specification by appropriate amendment to this permit.

"2. This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission unless Saxton Nuclear Experimental Corporation has submitted to the Commission (by amendment to the application) the complete, Final Hazards Summary Report (portions of which may be submitted and evaluated from time to time) and the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the specified procedures."

The Hearing Examiner's Intermediate Decision, issued January 21, 1960: *

"Conceptual design and design criteria for the major components of the facility have been developed in considerable detail in Saxton's application and in testimony at the hearings. Although detailed engineering design of the Saxton reactor is not complete, the information provided, as partly summarized hereafter, supports the conclusion that there is reasonable assurance that the Saxton reactor can be satisfactorily designed and safely operated. After all engineering details of the plant have been settled, Saxton will submit additional information to the Commission as an amendment to its application for construction permit in the form of a final hazards summary report, which information will be considered at the hearing on the operating license.

* * * * *

*The decisions of hearing examiners, cited in Appendices A and B, became final decisions of the Commission in the absence of exceptions by the parties or review by the Commission on its own motion.

"4. Sufficient information has been presented to provide reasonable assurance that a nuclear reactor of the general type described in the application and Preliminary Hazards Summary Report can be constructed and operated at the proposed location without endangering the health and safety of the public.

* * * * *

"6. There is reasonable assurance that technical information omitted from, and required to complete, the application will be supplied."

7. *Carolinas-Virginia Nuclear Power Associates, Inc.*, Construction Permit No. CPPR-7, issued May 4, 1960:

"C. This permit authorizes the applicant to construct the facility in accordance with the application and amendments thereto heretofore filed in this proceeding without further authorization.

"D. If the applicant desires Commission approval of any particular technical specification (such as the use of Zircaloy for pressure tubes), prior to consideration of a license to operate, it may request that the Commission grant specific approval of any technical specification by appropriate amendment to this permit.

"E. This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission until evidence has been adduced by Carolinas Virginia Nuclear Power Associates, Inc. concerning the tests performed of all designs and components of this proposed utilization facility, including, among others, specially designed use of heavy water, the U-pressure tubes, and their use of Zircaloy, and a basis has thereby been established as to all components when operated as a unit, that there is adequate protection to the health and safety of the public as required by the Atomic Energy

Act, as amended, and by the rules and regulations of the Commission."

The Hearing Examiner's Intermediate Decision, issued April 12, 1960:

"The final design of the reactor has not been completed; but criteria for its major components have been developed in considerable detail in the evidence produced in this proceeding. Present analyses and calculations from these preliminary design parameters indicate that no particularly unfavorable safety characteristics will arise from the nuclear, thermal, or hydraulic features of the reactor. The research and development program now being conducted by CVNPA, supplemented by the experience of similar reactors operating earlier than the reactor, affords reasonable assurance that the presently unresolved safety questions concerning its unproved features can be answered and thus assure that the reactor can be satisfactorly designed and safely operated. The final design criteria will evolve from the full-scale critical experiments which will begin in the spring of 1960. After all of the engineering details of the nuclear plant have been settled, CVNPA will submit additional information to the Commission as an amendment to its License Application in the form of a final hazards summary report.

"As will be provided hereinafter, in view of the untested character of certain components, and new design problems involved in this nuclear reactor, conditions will be attached to this construction permit requiring proof by tests of the adequacy and safety of the pressure U-tubes, specially designed for the use of heavy water and the zircaloy clad fuel elements, before this construction permit may be converted to an operating license. This evidence will be additional to that presented as the basis for opinions that the completed project has been constructed in accord-

ance with the specifications of this construction permit and will provide reasonable assurance that the health and safety of the public will not be endangered by its operation.

* * * * *

"3. There is sufficient information to provide reasonable assurance that the utilization facility of the general type proposed in the application, as amended, by CVNPA can be constructed at the location specified therein without endangering and will provide adequate protection to the health and safety of the public.

"4. There is reasonable assurance that the technical information omitted from and required to complete the application, including particularly that related to the special designed use of heavy water, the U-pressure tubes, and the use of zircaloy cladding of the fuel elements, will be supplied."

8. *Northern States Power Company,* Construction Permit No. CPPR–8, issued May 12, 1960:

"C. This permit authorizes the applicant to construct the facility in accordance with the application and amendments thereto heretofore filed in this proceeding without further authorization.

"D. If the applicant desires Commission approval of any particular technical specification (such as the design details of the various components and special design features, including the nuclear superheater, the aluminum alloy fuel elements, and circulation control system), prior to consideration of a license to operate, it may request that the Commission grant specific approval of any technical specification by appropriate amendment to this permit.

"E. This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission until the proposed research and development program has been completed

and evidence has been adduced by Northern States Power Company and it has been found by the Commission, that the Northern States Power Company's proposed nuclear utilization facility, including among other components which must be proven acceptable by tests described in the Intermediate Decision dated April 21, 1960, the novel features respecting the fuel elements in the boiler region of the core, the incorporation of a superheater with unproven types of fuel elements as an integral part of the basic reactor core, and the proposal that a variable rate of primary coolant recirculation be utilized for controlling the power level of the core, has been constructed and can we operated with adequate protection to and without endangering the health and safety of the public in accordance with the requirements of the Atomic Energy Act, as amended, and by the Rules and Regulations of the Commission."

The Hearing Examiner's Intermediate Decision, issued April 21, 1960:

"As stated, the proposed facility is a boiling water reactor having several new features and unique characteristics with which there has been no previous experience in any other reactor of a size comparable to that proposed by NSP. These are the use of aluminum alloy as a cladding for fuel in the boiler core, the use of cermet fuel of the type proposed to be used and the superheater core, and the variable rate of primary coolant recirculation proposed to be used for controlling the power level of the core.

* * * * *

"For the purposes of an operating license, both NSP and the Staff are agreed that further analysis and research and development explorations must be conducted before a judgment can be made that the superheater, the aluminum cladding, and the recircu-

lation rate of the primary coolant can be safely incorporated into this particular reactor.

* * * * *

"3. There is sufficient information available to provide reasonable assurance that the utilization facility of the general type proposed in the application, as amended, by NSP can be constructed and operated at the location specified therein without endangering and will provide adequate protection to, the health and safety of the public.

"4. There is reasonable assurance that, in accordance with (1) research and development programs outlined in the evidence, (2) the tests proposed to be undertaken of the components, and (3) the availability of proven features to be incorporated in the reactor should necessity therefore require, the technical information omitted from the application will be supplied, including particularly that related to fuel elements to be utilized in the boiler region of the core, the nuclear superheater and its fuel elements proposed to be incorporated as an integral part of the basic reactor core, and the controls of the variable rate of primary coolant recirculation."

9. *Consumers Power Company,* Construction Permit No. CPPR-9, issued May 31, 1960:

"C. This permit authorizes the applicant to construct the facility in accordance with the application and amendments thereto heretofore filed in this proceeding without further authorization.

"D. If the applicant desires Commission approval of any particular technical specification, prior to consideration of a license to operate, it may request that the Commission grant specific approval of any technical specification by appropriate amendment to this permit.

"E. This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission unless Consumers Power Company has submitted to the Commission (by amendment to the application) the complete Final Hazards Summary Report (portions of which may be submitted and evaluated from time to time) and the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the specified procedures.

The Hearing Examiner's Intermediate Decision, issued May 6, 1960:

"The determination of the existence of reasonable assurance that the utilization facility can be constructed and operated at the proposed site without undue risk to the health and safety of the public is limited by the present record to the conventional type of boiling water reactor with a power density of 30 kilowatts per liter. Many details of the design of Consumers' project remain to be completed. The Staff of the Commission has expressed the view that while it is believed that experiments will develop satisfactory designs, it remains to be demonstrated that the maximum specific power densities proposed can be safely achieved, and that clarification must be provided on the need for in-core instrumentation which may appear to be necessary as performance parameters are better understood. The adequacy of the control rod drive mechanisms may warrant re-examination at a later stage in the design calculations.

* * * * *

"3. There is sufficient information available to provide reasonable assurance that the utilization facility of the general type proposed in the application by Consumers can be constructed and operated at the

location specified without endangering and will provide adequate protection to the health and safety of the public.

"4. There is reasonable assurance that, in accordance with the research and development programs outlined in the evidence and the availability of alternate proven features to be incorporated in the reactor should necessity therefore require, the technical information omitted from the application will be supplied."

10. *Pacific Gas & Electric Co.*, Construction Permit No. CPPR–10, issued November 9, 1960:

"C. This permit authorizes the permittee to construct the facility in accordance with its application, as amended, and as described in the hearing record in this proceeding, without further authorization.

"D. If the permittee desires Commission approval of any particular technical specification or modification, prior to consideration of a license to operate, it may request that the Commission grant specific approval thereof, by appropriate amendment to this permit."

The Hearing Examiner's Intermediate Decision, issued October 17, 1960:

"Issue (1) The applicant has submitted sufficient information to provide reasonable assurance that a utilization facility of the general type proposed in the application can be constructed and operated at the proposed location without undue risk to the health and safety of the public;

"Issue (2) There is reasonable assurance that the technical information omitted from and required to complete the application will be supplied."

The further finding with respect to "the nuclear power reactor facility which is proposed" and the reservation on certain safety questions, were discussed in our main brief, p. 44, fn. 12.

APPENDIX B

Excerpts From Construction Permits Issued for Power Reactors and Accompanying Commission Decisions Related to Section 50.40 of the Regulations

1. *Consolidated Edison Company of New York, Inc.,* Construction Permit No. CPPR-1:

"C. Consolidated is financially qualified to assume responsibility for the payment of Commission charges for the special nuclear material to be furnished by the Commission, to undertake and carry out the proposed use of the material for a reasonable period of time, and to construct and operate the reactor in accordance with the regulations contained in Title 10, Chapter 1, C.F.R.

"D. Consolidated and the Babcock & Wilcox Company, the contractor selected by Consolidated to design and construct said reactor, are technically qualified to design and construct the reactor."

2. *Commonwealth Edison Company,* Construction Permit No. CPPR-2:

"C. Commonwealth is financially qualified to assume responsibility for the payment of Commission charges for the special nuclear material to be furnished by the Commission, to undertake and carry out the proposed use of the material for a reasonable period of time, and to construct and operate the reactor in accordance with the regulations contained in Title 10, Chapter 1, C.F.R.

"D. Commonwealth and General Electric Company, the contractor selected by Commonwealth to design and construct said reactor, are technically qualified to design and construct the reactor."

3. *General Electric Company,* Construction Permit No. CPPR–3:

"C. GE is financially qualified to construct and operate the reactor in accordance with the regulations contained in Title 10, Chapter 1, C.F.R.; to assume financial responsibility for the payment of Commission charges for special nuclear material and to undertake and carry out the proposed use of such material for a reasonable period of time.

"D. GE is technically qualified to design and construct the reactor."

4. *Power Reactor Development Company,* Construction Permit No. CPPR–4, as amended is set forth at R. 715, the Commission's decision at R. 630.

5. *Yankee Atomic Electric Company,* Construction Permit No. CPPR–5.

The Commission Order, October 31, 1957, states:

"C. Yankee and its contractors, Westinghouse Electric Corporation and Stone & Webster Engineering Corporation, are technically qualified to design and construct the proposed reactor.

* * * * *

"E. The issuance of a construction permit to Yankee will not be inimical to the common defense and security or to the health and safety of the public."

6. *Saxton Nuclear Experimental Corporation,* Construction Permit No. CPPR–6.

The Hearing Examiner's Intermediate Decision states:

"3. Westinghouse Electric Corporation is technically qualified to design and construct the reactor, and accordingly, Saxton has provided for adequate technical qualifications to design and construct the proposed facility.

* * * * *

"5. Saxton is financially qualified to design and construct the proposed facility.

* * * * * *

"7. The issuance of a construction permit to Saxton will not be inimical to the common defense and security or to the health and safety of the public."

7. *Carolinas Virginia Nuclear Power Associates, Inc.*, Construction Permit No. CPPR–7.

The Hearing Examiner's Intermediate Decision states:

"5. CVNPA, Westinghouse, and Stone & Webster, collectively, are technically qualified to design and construct the proposed utilization facility.

"6. CVNPA is financially qualified to engage in the proposed activities in accordance with the Atomic Energy Act, as amended, and the rules and regulations of the Commission.

"7. The issuance of the proposed construction permit to CVNPA, substantially in the form attached to the Notice of Hearing issued herein, as modified by the order hereinafter made, will not be inimical to the common defense and security or to the health and safety of the public."

8. *Northern States Power Company*, Construction Permit No. CPPR–8.

The Hearing Examiner's Intermediate Decision states:

"5. NSP and Allis-Chalmers Manufacturing Company, collectively are technically qualified to design, construct, and operate the proposed utilization facility.

"6. NSP is financially qualified, and as supplemented by contributions from associated electric utilities is able to engage in the activities proposed in its application in accordance with the Atomic Energy

Act, as amended, and the Rules and Regulations of the Commission.

"7. The issuance of the proposed construction permit to NSP, substantially in the form attached to the Notice of Hearing issued herein, as modified by the Order hereinafter made, will not be inimical to the common defense and security or to the health and safety of the public."

9. *Consumer Power Company,* Construction Permit No. CPPR-9.

The Hearing Examiner's Intermediate Decision states:

"5. Consumers, General Electric Company, and Bechtel Corporation, collectively, are technically qualified to design, construct, and operate the proposed utilization facility.

"6. Consumers is financially qualified and able to engage in the activities proposed in its application in accordance with the Atomic Energy Act, as amended, and the Rules and Regulations of the Commission.

"7. The issuance of the construction permit in substantially the form attached hereto will not be inimical to the common defense and security, nor to the health and safety of the public."

10. *Pacific Gas and Electric Company,* Construction Permit No. CPPR-10.

The Hearing Examiner's Intermediate Decision states:

"Issue (3) The applicant, collectively with General Electric Company and Bechtel Corporation as herein proposed, is technically qualified to design and construct the proposed facility;

"Issue (4) The applicant is financially qualified to engage in the proposed activities; and

"Issue (5) Construction of the reactor will not be inimical to the common defense and security or to the health and safety of the public."

APPENDIX C

Analysis of Respondents' List of Alleged Reactor Accidents, Prepared by AEC Division of Licensing and Regulation

I. REACTORS IN THE UNITED STATES

A. *Accidents Causing Death or Observed Injury to Operating Personnel*

1. *Reactor:* SL–1, National Reactor Testing Station, Arco, Idaho, boiling water reactor, used for power production, prototype for low-power plant at a remote site.

Date: January 3, 1961.

Nature of Incident: Reactor excursion occurred during shutdown for maintenance. Control rods were disconnected from drives and nuclear instrumentation was not in use. Some of the control rods ere ejected from the core.

Radiation level: Over 1000 r/hr. in the reactor building.

*Injuries:** 3 fatalities, the operating personnel in the reactor building.

Evaluation: Evaluation of this accident is still in progress. It appears that maintenance procedures were partially at fault and that the reactivity condition of the reactor was not adequately known or understood at the time of the incident. Although the reactor was not housed in a containment building, offsite contamination was low, despite the very extensive contamination inside the reactor building. No significant radioactive material was released beyond the reactor area.

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* "Injuries" in this analysis refers to clinically observed or reported injuries.

B. *Accidents Causing Radiation Overexposure to Operating Personnel Without Observed Injury*

2. *Reactor:* General Electric Test Reactor (GETR); Pleasanton, California, pressurized water reactor, used for materials testing.

Date: March 10, 1960.

Nature of Incident: A technician preparing a GETR fuel element for transfer from the storage pool to the Materials Laboratory inhaled tracer amounts of radioiodine.

Radiation level: 48 rads to the thyroid. (Other employees received doses to the thyroid of from 1.8 to 7 rem).

Injuries: None.

Evaluation: This was not a reactor accident. Its connection with the GETR consists only in that the fuel element from which the iodine was released had previously been used in the reactor. There were no perceptible injurious consequences. Such consequences can be caused only by radiation exposure to the thyroid many times greater than these.

3. *Reactor:* Materials Testing Reactor (MTR), National Reactor Testing Station, Arco, Idaho, water-cooled and -moderated reactor with highly enriched plate fuel, used for materials irradiation and testing purposes.

Date: July 23, 1956.

Nature of Incident: Eight men were working on the top of the reactor near the reactor tank opening (which was uncovered), the reactor being shut down for refueling and maintenance. The water level in the reactor tank was lowered during the shutdown period to facilitate insertion and removal of experiments in the reactor. The men were exposed when a radioactive reactor component was placed in a posi-

tion where it was not adequately shielded because of the lowered water level.

Radiation Level: External doses at top of reactor were as follows: 21 r, 6.2 r, 3.9 r, 6.1 r, 10.6 r, 2.9 r, 2.6 r, and 2.5 r.

Injuries: The men were placed under routine medical observation, but no illness or other radiation-induced effects were observed.

Evaluation: This incident was caused by inadequate radiation monitoring and questionable maintenance procedures. No radioactive material was released from the reactor, and the reactor was not affected by the incident. No effect on persons other than those whose action was responsible for the unsafe radiation condition were affected or could have been affected. Full-time radiation monitoring service has since been provided at the reactor tank opening to prevent any such future exposures.

4. *Reactor:* Chicago Pile, Argonne National Laboratory, Illinois.

Date: June 1952.

Nature of Incident: Manual withdrawal of a control rod from a reactor caused an accidental supercriticality. When the control rod was released, the reactor was shut down.

Radiation Levels: Personnel exposures for the four persons standing on or near the reactor were 190 rem, 160 rem, 70 rem, and 12 rem.

Injuries: The four persons exposed were hospitalized for observation and no injuries or symptoms of radiation illness were noted.

Evaluation: This reactor is an experimental facility at a National Laboratory, and has a considerable de-

gree of flexibility. The above accident was caused by the operators' failure to drain the reactor of water before the control rod was withdrawn. Criticality in the drained reactor would have been impossible. Included in the protective measures taken after the accident was the absolute prevention of access to the room when the reactor was not drained of water.

C. *Other Accidents and Operating Difficulties*

5. ***Reactor:*** Dresden Nuclear Power Station (Commonwealth Edison Co.), Dresden, Illinois, boiling water reactor, used for power production as central station.

Date: November 15, 1960.

Nature of Incident: One of the 80 control rods failed to follow its drive mechanism upon a rod withdrawal, rod was then driven into core and locked in place. Subsequent examination, after shutdown of reactor, revealed that index tube in drive had fractured, and disclosed surface cracks in some drive components made of 17–PH steel.

Radiation level: None.

Injuries: None.

Evaluation: The situation resulted from stress corrosion of the steel used in the shaft of the drive mechanism. No accident occurred and no hazard existed. All other drive mechanisms performed satisfactorily and appropriate precautions were taken with the failed drive. The drive mechanisms have been modified, by use of different materials, different heat treatment and fabrication controls, to reduce suscep-

tibility to stress corrosion and eliminate further operational difficulties.

6. *Reactor:* Westinghouse Test Reactor (WTR), Waltz Mill, Pennsylvania, pressurized water reactor, used for high-flux materials irradiation.

Date: April 3, 1960.

Nature of Incident: Fuel element had a small (about one-half square inch) area in which bond between fuel and clad was defective. A hot spot developed, the fuel swelled and led to coolant flow restriction and subsequent fuel element failure.

Radiation level: 4–6 r per hr. in the reactor head tank. No one was exposed to this, however.

Injuries: None. No exposures to employees or others above permissible limits.

Evaluation: Although this incident was a serious nuisance and produced large quantities of low-level waste, no hazard was involved. The reactor system was designed in anticipation of possible fuel element failure (the normal practice in high-power reactor design) and no significant activity escaped the facility. Remedial actions include more careful inspection of the fuel elements before their insertion into the reactor and the installation of additional waste holdup tankage and a larger waste evaporator to facilitate cleanup after any future incidents of this type.

7. *Reactor:* Homogeneous Reactor Experiment No. 2 (HRE–2), Oak Ridge National Laboratory, Oak Ridge, Tennessee; aqueous homogeneous reactor used for experimental and developmental purposes.

Date: February 1960.

Nature of Incident: Corrosion of the barrier between the core and blanket regions caused an additional hole in this barrier. A similar hole which occurred about two years previously had not been repaired, and since that time, the reactor had been

operating with fuel solution in both the core and the blanket regions. Thus no substantial change in the condition of the reactor was produced by this new leak.

Radiation Level: None.

Injuries: None.

Evaluation: This was not an accident. One of the principal purposes of the facility is the testing of compatibility of materials, and leaks such as this are not considered incidents or even unexpected events, but rather constitute experimental results. No radioactive material was released when this second hole was produced.

8. *Reactor:* Sodium Reactor Experiment (SRE), Santa Susana, California, sodium-cooled, graphite-moderated reactor used for experimental and developmental purposes.

Date: July 24, 1959.

Nature of Incident: Decomposition products of organic impurities in the coolant caused overheating and melting of fuel. The core was extensively damaged but no significant amount of radioactive material was released.

Radiation Level: None.

Injuries: None.

Evaluation: One of the primary purposes of this facility is the investigation of the compatibility of materials for use in such a facility, and an incident such as this is not totally unanticipated. There are appropriate safety procedures and no hazard resulted.

9. *Reactor:* Situation referred to under "ANP" actually occurred in Heat Transfer Reactor Experiment No. 3 (HTRE–3) at National Reactor Testing Station, Arco, Idaho, gas-cooled, solid-moderated reactor, used for experimental purposes for aircraft propulsion program.

Date: November 18, 1958.

Nature of Incident: Radioactive material was released from the reactor.

Radiation Level: .03 per cent of the site was contaminated. No persons were exposed and no evacuation of personnel was necessary, since facility operations are carried out remotely from a shielded bunker.

Injuries: None.

Evaluation: This reactor is an experimental facility designed and located so that in experimental testing of a nuclear propulsion plant, releases of radioactive material to the atmosphere may be permitted to occur safely. Thus, no hazard to operating personnel or to others existed as a consequence of this release.

10. *Reactor:* Homogeneous Reactor Experiment No. 2 (HRE–2), Oak Ridge National Laboratory, Oak Ridge, Tennessee, aqueous homogeneous reactor, used for experimental and developmental purposes.

Date: April 4, 1958.

Nature of Incident: Corrosion of the barrier between core and blanket regions of the reactor produced a hole in this barrier. Liquid fuel thus filled the blanket region in addition to the core. No fuel or radioactive material escaped from the reactor, and operation was continued with fuel in both regions.

Radiation Level: None.

Injuries: None.

Evaluation: This was not an accident. One of the principal purposes of this facility is the testing of materials compatibility and leaks such as this are not unexpected, and constitute useful experimental results. (See Item 7.)

11. *Reactor:* Godiva, Los Alamos Scientific Laboratory, New Mexico; bare, fast critical assembly, used for basic fast reactor studies.

Date: February 12, 1957.

Nature of Incident: A remotely operated fissionable material assembly produced a neutron excursion greater than intended, resulting in damage to the assembly. Total energy of the excursion was 1.2 x 10^{17} fissions or about one kilowatt hour.

Radiation Level: None, at the point of nearest approach to the facility (about one-quarter of a mile from the assembly).

Injuries: None.

Evaluation: This facility is an experiment operated for the purpose of intentionally producing neutron bursts and is constructed and operated in a manner much different than a normal reactor plant. It is unshielded. Because of the experimental nature of the facility, all persons are excluded from its vicinity and it is remotely controlled from a safe distance, one-quarter mile away. Although the particular neutron burst cited here was larger than was intended, and was severe enough to violently disassemble the system and shut down the assembly, no hazard to any persons existed.

12. *Reactor:* Kinetic Experiment on Water Boilers (KEWB), Santa Susana, California; aqueous homogeneous reactor (water boiler), used for burst experiments in aqueous homogeneous reactors.

Date: January 4, 1957.

Nature of Incident: A small quantity of volatile radioactive material was released into the reactor room by leakage from around a valve stem when the valve was operated. This resulted from failure of a vacuum pump which normally maintained a negative pressure on the gas sampling line in which the valve was located. The building was evacuated until activity levels returned to normal background (less than one day).

Radiation Level: Above normally-accepted levels for continuous indefinite breathing. Building was vacated in about 10 seconds, and no dose of any significance was received by personnel. (No detectable external dose, internal dose less than 50 mr, no activity detectable by urinalysis.)

Injuries: None.

Evaluation: The equipment that failed was a part of the auxiliary plumbing system and not an integral part of the reactor system. Required cleanup effort was comparable to that which might be required routinely in a radioisotope laboratory. As already noted, monitoring procedures adequately detected the contamination and evacuation was completed without difficulty, so that there was no hazard to personnel or others.

13. ***Reactor:*** Homogeneous Reactor Experiment No. (HRE–2), Oak Ridge National Laboratory, Oak Ridge, Tennessee; aqeous homogeneous reactor, used for development and experimental purposes.

Date: November 1956.

Nature of Incident: Microscopic cracking caused by stress corrosion was discovered in the helium leak detector system and in some of the flanges to which the system's tubing is connected. The condition was discovered during preliminary non-nuclear checkout tests of the plant.

Radiation Level: None.

Injuries: None.

Evaluation: This was not a reactor incident. No nuclear materials were involved in the plant, which had not yet been fueled for operation. Corrosion was caused by chloride ion contamination of the stainless steel leak-detection tubing, as a result of inadequate cleaning and inspection of this auxiliary system tubing. (Extreme care had been taken to exclude all

chlorides from the components of the reactor system itself, but less care was apparently exercised with respect to the auxiliary tubing.) This defect was discovered during non-nuclear checkout of the system "plumbing." The purpose of such checkout is to disclose any such system defects before nuclear fuel is installed in the plant. The discovery of the stress corrosion condition caused a delay of many months in the startup of the HRE–2, but no safety problems were involved.

14. *Reactor:* Seawolf Submarine (S2G), intermediate, sodium-cooled reactor, used for naval propulsion, experimental.

Date: September 6, 1956.

Nature of Incident: Several leaks were detected in superheater and steam generator tubes over a period of time. These tubes are of double-walled construction with a barrier of non-radioactive NaK in the annulus between the walls, and proved very difficult to maintain 100% leaktight.

Radiation Level: None.

Injuries: None.

Evaluation: Materials problems such as this are not uncommon in experimental and development systems. Leaks had developed in the land-based prototype for the reactor (S1G), and their occurrence in the actual ship reactor was not totally unexpected. In order to stop the leaks, it was necessary to block off the affected tubes, resulting in a decrease in the maximum power and speed attainable by the ship. Since the leaks were internal and steam contamination was protected against by means of the intermediate NaK barrier, no question of radiation or radioactive material was involved. The incident was a significant operational nuisance and development problem, but no safety problem was presented.

15. *Reactor:* Experimental Breeder Reactor No. 1 (EBR-1), National Reactor Testing Station, Arco Idaho, fast breeder, sodium cooled reactor, used for experimental fast reactor studies.

Date: November 29, 1955.

Nature of Incident: While the reactor was undergoing a series of scheduled experiments, rapid power surges were intentionally introduced and fuel temperatures were intentionally forced above their normal limits. Automatic protective instrumentation and shutdown devices were disconnected in order to permit the power surge tests without automatic shutdown. During the last test of the series, the reactor overheated rapidly and extensive fuel melting occurred before the operator could initiate manual shutdown.

Radiation Level: None.

Injuries: None.

Evaluation: The EBR-1 is an experimental reactor located in a remote site in order that it can be operated under extreme conditions and in an abnormal manner without producing a safety hazard. When the meltdown occurred, the tests being performed involved the introduction of deliberate and severe abnormalities, with normal automatic protective equipment disconnected, and the possibility of damage to the reactor under such conditions was clearly realized. The damage which did occur was thus more an experimental result than a reactor incident, and resulted in no adverse consequences from the safety standpoint.

16. *Reactor:* One of the Hanford Production Reactors, Hanford, Washington, graphite moderated, water cooled reactor, used for plutonium production.

Date: November 1, 1955.

Nature of Incident: A ruptured fuel slug was forcibly loosed and then flushed from its tube by a high pressure water stream. A flash of flame occurred as the slug came out of the tube at the rear of the reactor. The back of the reactor required decontamination. Some of the surrounding area on the site was slightly contaminated.

Radiation Level: Unknown (low in occupied locations).

Injuries: None.

Evaluation: The incident necessitated a decontamination effort, but there was no actual or potential effect on operation of the reactor, and no potential propagation of the fuel slug failure to other tubes of the reactor. Fuel slug failures are provided for in the design of the reactor and plant equipment. Monitoring instrumentation is in continuous use for the detection of plugging or reduction of coolant flow in the reactor tubes, and equipment is available for removal of failed fuel slugs from the tubes without hazard to plant personnel or others. The plant is so located that the release of fission products associated with fuel failures such as this do not constitute an offsite contamination problem or hazard.

17. *Reactor:* Raleigh Research Reactor (North Carolina State College), Raleigh, N.C., aqueous homogeneous (water boiler) reactor, used for University research and training.

Date: May 1955.

Nature of Incident: The stainless steel core of the reactor developed a leak, allowing fuel solution to leak into the surrounding chamber and into the cooling water.

Radiation Level: None.

Injuries: None.

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Evaluation: This failure is typical of the materials problems that have been associated with this and other solution-type reactors. Reactors of this type are designed so that a core tank leak will not permit fuel solution containing radioactive material to escape from the reactor system, thus protecting against hazard if leaks such as this do occur.

18. *Reactor:* Materials Testing Reactor (MTR), National Reactor Testing Station, Arco, Idaho; water moderated and cooled reactor with highly enriched plate fuel, used for materials irradiation and testing purposes.

Date: June 1954.

Nature of Incident: Bulging of some fuel plates was discovered. This caused contact between plates and overheating in a few localized spots. Some fission products were released to the coolant.

Radiation Levels: Up to 3 r/hr on contact at some points in the cooling system.

Injuries: None.

Evaluation: The increased radiation levels of the cooling system caused some short-term operating problems, because the allowable working time for maintenance of the cooling system was reduced. During normal operation, the system is well shielded and no problem was produced by the incident. Once the source of activity had been removed, maintenance time limitations were able to be relaxed. Fuel elements were modified to prevent a recurrence of this incident. No hazard to operating personnel or others existed as a result of this incident.

19. *Reactor:* Godiva, Los Alamos Scientific Laboratory, New Mexico, bare, fast, critical assembly, used for basic fast reactor studies.

Date: February 3, 1954.

Nature of Incident: The reactor was made exces-

sively supercritical during a study of the properties of supercritical bursts. This study involved above-normal burst magnitudes. An error in preparation for the experiment caused this particular burst to be greater than expected, by about a factor of three. The total energy generated in the burst was approximately one-half of one kilowatt-hour (6 x 10[illegible] fissions).

Radiation Levels: None, at the point of nearest approach to the facility.

Injuries: None.

Evaluation: As indicated in item 11, this experimental facility is operated remotely to assure safety of personnel under normal conditions and also under the abnormal conditions of an accident. The only adverse effect of the experiment was damage to the assembly, to the extent of $600, and time lost in repair of the assembly before the next burst.

20. *Reactor:* Clementine, Los Alamos Scientific Laboratory, New Mexico, plutonium-fueled, fast, mercury-cooled reactor, used for basic fast reactor studies.

Date: Prior to dismantling of reactor in December 1957.

Nature of Incident: One of the fuel elements failed, releasing plutonium into the mercury coolant. Since the research and development studies upon the reactor had been completed, it was shut down and later dismantled.

Radiation Levels: None known. This failure is not of a type which would be expected to release a significant amount of radioactive material.

Injuries: None.

Evaluation: This was not a reactor accident. The facility was of a very early fast reactor design and was constructed for developmental purposes. Materials failures of this type cited here are not unexpected or unprepared for in such facilities. Since the re-

actor's planned objectives had been fulfilled at the time of the failure, it was decided not to clean up the coolant and resume operation, but to dismantle the reactor.

21. *Reactor:* One of the reactors at Los Alamos Scientific Laboratory, New Mexico.

Date: December 1949.

Nature of Incident: Supercriticality occurred in the reactor, caused by manual testing of control rod mechanisms.

Radiation Level: One employee was exposed to 2.5r (not above permissible level in effect at that time).

Injuries: None.

Evaluation: The incident occurred in an experimental facility at a remote site. It was caused by manual control rod testing. Such testing is characteristic only of the early stage of reactor development at the time of the incident (1949) and is not practiced today.

22. *Reactor:* X-10 Reactor, Oak Ridge National Laboratory, Oak Ridge, Tennessee, graphite moderated, air cooled reactor used for research and isotope production.

Date: 1947–1948.

Nature of Incident: Fuel elements of the type in use during this period experienced failures at a low rate. On two occasions, one in 1947 and one in 1948, such failure went undetected until the fuel element jacket had swelled enough to restrict cooling air flow in one channel. This caused overheating and failure of other elements in the channel. In each instance, the channel was damaged in removal of the elements and its further use was abandoned. There are 1248 channels in the reactor of which 821 are fueled.

Radiation Levels: None.

Injuries: None.

Evaluation: From the standpoint of hazard, this was not a reactor accident. The reactor operates at a low power level and contains many thousands of fuel elements, so that the quantity of fission products contained in each element is very small. Furthermore, the restriction of air flow caused in an incident such as this serves to block the normal path of release of any radioactive material which might escape from a failed fuel element. While the incident affected operating efficiency, there was no danger to any employee or member of the public.

II. REACTORS IN FOREIGN COUNTRIES*

A. *Accidents Causing Death or Observed Injury to Operating Personnel*

23. *Reactor:* Critical assembly at the Boris-Kidrich Institute, Yugoslavia; natural uranium, heavy water moderated, critical assembly, used for reasearch purposes.

Date: October 18, 1958.

Nature of Incident: Accidental criticality caused by uncontrolled pumping of heavy water into the unshielded tank of the critical assembly.

Radiation Level: The average exposure to personnel located at distances varying from 10 ft. to 25 ft. from the reactor is reported to have been 49 rems of thermal neutrons, 223 rems of epithermal neutrons, 116 rems of fast neutrons, and 295 rems of gamma radiation.

Injuries: One person died as a result of overexposure. Five persons received severe overdoses of radiation but have been reported recovering after receiving medical treatment.

Evaluation: The facility was a zero-power critical assembly, used for research. It was unshielded and

*The analysis of foreign incidents listed by respondents is based solely upon published reports and statements.

the procedure for starting up was to pump the moderator, heavy water, into the reactor tank. This is a major operation and should have been properly scheduled and properly controlled. The severe accident reported came about because (1) there was a failure to control and schedule the pumping, which should not have been undertaken with persons near the unshielded assembly; (2) the monitoring, scram and other safety systems had been turned off.

B. *Accidents Causing Radiation Overexposure to Operating Personnel Without Observed Injury*

24. *Reactor:* NRU, Chalk River, Canada, natural uranium reactor, heavy water moderated and cooled, used for plutonium production, research and materials testing.

Date: May 23, 1958.

Nature of Incident: The incident which triggered the chain of events leading to more serious difficulties was in itself minor. The reactor went through an automatic shutdown initiated by an excessive rise-of-power. This rise-of-power may have been caused by a phenomenon known as water logging of failed fuel elements. It was decided to remove three damaged fuel elements. During this phase of operations, one of the three damaged fuel elements jammed after being raised part way into the carrier flask and was without cooling for 10 minutes. The resulting overheating and oxidation caused a 3 ft. long piece to fall out of the carrier flask when it was being moved over towards the storage area, and to burn in the open air of the reactor room before being extinguished with wet sand.

Radiation Level: Reported radiation in the reactor room after the first incident was 100–1000 mr/hr. However, after the second incident, the radiation fields were probably in excess of 1000 r/hr.

Injuries: Eighteen employees were exposed to radiation as a result of this incident. Of those exposed during the incident, none received exposure higher than 5.3 roentgens. During the cleanup and removal of debris, the highest exposure received was about 6 roentgens. None of these 18 individuals showed any evidence of injury.

Evaluation: The initial incident was a minor one. Contamination of the reactor room and exposure of personnel resulted from the attempt to move the highly radioactive damaged fuel element without assuring that the transfer operations could be performed properly.

25. *Reactor:* Windscale #1, Windscale, England, natural uranium, graphite moderated, air cooled reactor, used for plutonium purposes.

Date: October 10, 1957.

Nature of Incident: During a special annealing operation (Wigner release) of the graphite pile, there was a failure of fuel cladding, which led to exposure of the uranium fuel, oxidation and then to fire in the combustible mass of graphite and uranium metal. Radioactivity was released out the stack (through a filter), dispersed to the atmosphere and caused contamination in the vicinity.

Radiation Level: Not given.

Injuries: Fourteen workers had exposures over the normal 3.0 r for a 13-week period, the highest exposure being 4.66 r. No injuries reported from such exposures or from nearby contamination.

Evaluation: This incident took place during a special plant operation undertaken to release energy stored in graphite by effects of irradiation. This phenomenon of a graphite pile, and the necessity for such operation, was discovered earlier (see item 41). It was reported that this incident occurred because

the operator failed to take sufficient time to perform the Wigner release and there were inadequacies in the operator's training and the written procedures. This reactor is cooled by blowing air through the pile consisting of fuel elements and graphite slabs and exhausting the air out of the stack. Hence, this reactor type does not exhibit the gas-tight plant containment usually associated with power reactor installations. As a result, the radioactive material was released to the atmosphere. The incident necessitated extensive repair and decontamination. However, there were no excessive exposures to radiation and no injurious consequences detected or reported.

C. *Other Accidents and Operating Difficulties*

26. *Reactor:* G–2, Marcoule, France, natural uranium reactor, graphite moderated, CO_2 cooled, used for plutonium production.

Date: July 6, 1960.

Nature of Incident: There was a mechanical rupture of a joint between the loading mechanism and a fuel canal. As a result, a small quantity of CO_2 gas under operating pressure of 220 psi escaped into the reactor hall.

Radiation Level: Not reported. It was stated by a spokesman for Le Commissariat à l'Energie Atomique that the escaping gases were only slightly radioactive.

Injuries: None reported.

Evaluation: Mechanical failure of a component led to escape of small amount of radioactivity into the reactor hall, which was immediately detected by the monitoring instrumentation. The reactor was shut down, pressure reduced to stop the leak and appropriate maintenance work undertaken. No hazard to health and safety of operating personnel was presented.

27. *Reactor:* Research Reactor, Berlin, Germany, aqueous homogeneous reactor, light water moderated and cooled, used for research purposes.

Date: March 1960.

Nature of Incident: A welded metal piece came loose inside the catalyst chamber and impeded the flow of gas.

Radiation Level: None. There was no escape of radioactivity outside the reactor.

Injuries: None reported.

Evaluation: Water decomposes under radiation to hydrogen and oxygen, and this reactor was equipped with a loop through which these non-radioactive gases were drawn, introduced into a catalyst chamber and returned to the reactor vessel as water. The failure of a component of that chamber did not present any safety problem.

28. *Reactor:* Japanese Research Reactor #1, Tokai Mura, aqueous homogeneous reactor, light water moderated and cooled, used for research purposes.

Date: December 8, 1959.

Nature of Incident: Officials at the reactor plant stated that a minor incident occurred which resulted in radioactive contamination of the reactor section, and that the radioactivity was completely contained in the reactor section. Insufficient information is available to us to give further details or permit of any evaluation.

29. *Reactor:* AGN–211, Basel, Switzerland, solid homogeneous reactor, polyethylene moderated, light water cooled, used for research purposes.

Date: November 10, 1959.

Nature of Incident: Failure of the polyethylene matrix around the fuel.

Radiation Level: Radioactivity level of the reactor water increased to a maximum of 3×10^{-4} microcuries

per cm^3 after 1½ hrs. of operation at 100 watts. No increase in radiation in areas accessible to individuals.

Injuries: No overexposure or injuries reported.

Evaluation: In this small research reactor, the fuel is dispersed as grains in a polyethylene matrix immersed in the reactor water. Due to a failure of the bonding between some of the fuel grains and the matrix, small quantities of gas escaped into the reactor water. The leak stopped upon reduction of power to 50 watts. This difficulty had no adverse consequences for the health and safety of personnel.

30. ***Reactor:*** EL–2, Saclay, France, natural uranium, heavy water moderated, CO_2 cooled reactor, used for research and isotope production.

Date: February 16, 1959.

Nature of Incident: Overheating of fuel element resulted in rupture of cladding and the escape of radioactivity into the CO_2 stream.

Radiation Level: It is reported that there was no trace of radioactive contamination outside the reactor into the reactor room proper.

Injuries: No overexposure or injuries reported.

Evaluation: A breach in the integrity of the cladding in a fuel element caused escape of fission products into the coolant, a minor operating difficulty. The monitoring system is equipped to detect such escape. In each of such reported incidents at Saclay, the difficulty was immediately detected. Thereafter, the reactor was shut down and appropriate maintenance work done to locate and replace any defective fuel element, and clean up the coolant gas where necessary. In some cases the repair work was apparently time-consuming and expensive. However, there was no threat to the health and safety of the operating personnel at any time.

?.. *Reactor:* EL-2, Saclay, France, natural uranium, heavy water moderated, CO_2 cooled reactor, used for research and isotope production.

Date: December 27, 1958.

Nature of Incident: Failure of the cladding of a fuel element resulting in escape of radioactivity into the CO_2 stream.

Radiation Level: Certain components in the closed CO_2 system indicated 4 times the maximum permissible level.

Injuries: No overexposure or injuries reported.

Evaluation: Same as in item 30.

32. *Reactor:* Calder Hall, Calder Hall, England, natural uranium reactor, graphite moderated, CO_2 cooled, used for power production.

Date: June 28, 1958.

Nature of Incident: There was a mechanical failure of a steam turbine.

Radiation Level: None.

Injuries: None.

Evaluation: The failure of the steam turbine led to a shutdown of the reactor, since the latter was producing steam for the turbine. The incident, however, was a mechanical failure in the turbine which had nothing to do with the nuclear installations of the plant.

33. *Reactor:* EL-3, Saclay, France, slightly enriched uranium reactor, heavy water cooled and moderated, used for research and materials testing.

Date: April 13, 1958.

Nature of Incident: Aluminum channel in which a fuel element was situated broke and fell as result of vibration and lack of support. This interrupted the forced circulation cooling of the fuel element, and led to overheating and rupture of the fuel element.

Radiation Level: No contamination of the reactor room, established by analysis of the air as well as a check of the personnel. Any radioactivity which escaped from the fuel slug was confined to the primary coolant and the closed helium gas systems.

Injuries: No overexposure or injuries reported.

Evaluation: The release of radioactivity into the coolant by this mechanical failure of a component was promptly detected. The situation is similar to that evaluated in item 30.

34. *Reactor:* SAPHIR, Würenlingen, Switzerland, pool type reactor, 20% enriched uranium, light water cooled and moderated, used for research purposes.

Nature of Incident: No incident of any kind is reported at the reference given in respondents' brief.

35. *Reactor:* EL-2, Saclay, France, natural uranium, heavy water moderated, CO_2 cooled reactor, used for research and isotope production.

Date: November 26, 1957.

Nature of Incident: Overheating of an aluminum clad uranium slug because of insufficient cooling water flow, hole in cladding released radioactivity into cooling water.

Radiation Level: No increase of the radiation level in the reactor hall reported.

Injuries: No overexposure or injuries reported.

Evaluation: Same as item 30.

36. *Reactor:* G-1, Marcoule, France, natural uranium, graphite moderated, air-cooled reactor, used for power production demonstration and plutonium production.

Date: October 26, 1956.

Nature of Incident: The failure of the canning exposed an uranium slug with subsequent oxidation and dispersion of fission products into the reactor's cooling air.

Radiation Level: It was reported that the maximum concentration of radioactive material in the air was 5 x 10^{-8} microcuries/cm^3 for a few minutes at the base of the stack. It is noted, however that the measurements of the activity in the air by th stations outside the site always remained well under the maximum permissible limit.

Injuries: It was reported that personnel were not exposed to radiation above permissible limits and no injurious consequences were noted.

Evaluation: The failure of fuel canning released a small quantity of radioactive fission products into the coolant. This was promptly detected by monitoring instrumentation. The reactor was shut down and appropriate action taken. The report stated that a minor accident of this order is not dangerous either for the personnel or for the reactor.

37. *Reactor:* J E E P, Kjeller, Norway, natural uranium, heavy water moderated and cooled reactor, used for research purposes.

Date: February, 1954.

Nature of Incident: The incident occurred in a channel of the reactor used for irradiation purposes. The aluminum canning in an irradiation channel failed, exposing an uranium slug, with subsequent oxidation.

Radiation Level: Not given, but required evacuation of reactor hall. The report stated that radioactive dust spread into the reactor hall when the irradiation channel was opened, personnel were evacuated and had to don protective clothing and masks before reentering the building.

Injuries: No overexposure or injuries reported.

Evaluation: This incident did not involve the reactor fuel elements or any defect in the operation of the reactor itself. The failure occurred in a can

placed in the reactor to be irradiated for experimental purposes. It was apparently due to careless experimental procedures, and necessitated appropriate maintenance and decontamination.

38. *Reactor:* Windscale #1, Windscale, England, natural uranium, graphite moderated, air cooled reactor, used for plutonium production.

Nature of Incident: No incident is reported in the reference given in respondents' brief.

39. *Reactor:* Russian heavy water research reactor (HWRR), slightly enriched uranium reactor, heavy water moderated and cooled, used for research purposes.

Date: 1953.

Nature of Incident: Failure of the cladding of an uranium rod, releasing radioactivity into the reactor vessel.

Radiation Level: The presence of fission products in the reactor's helium blanket was reported.

Injuries: No overexposure or injuries reported.

Evaluation: As reported, the initial incident was a failure of fuel cladding, a minor difficulty which was detected and which led to appropriate routine measures to replace the fuel element. The subsequent falling of the element and damage to the reactor tank, necessitated a difficult repair job. However, such repairs can be done safely and no injury or overexposure is reported.

40. *Reactor:* NRX, Chalk River, Canada, natural uranium, heavy water moderated, light water cooled reactor, used for research purposes.

Date: December 13, 1952.

Nature of Incident: During an experiment, a power surge occurred because of mechanical failure of the safety shutdown system, resulting in melting of part of the fuel rods.

Radiation Level: Not given. Plant personnel were required to evacuate the site.

Injuries: No overexposure or other type of injuries reported. At times during the repair work it became necessary to allow individuals to take a thirteen-week dosage (3.9 roentgen) in a matter of a day or two and subsequently bar them from the radioactive area for a period of 13 weeks.

Evaluation: This accident took place during a period of experimental work with the reactor and was probably associated with special experimental conditions. It was a serious accident in terms of the extensive repair and decontamination work required in the reactor building and the reactor vessel. No adverse health and safety consequences were noted to operating personnel and there was no danger to the public.

41. *Reactor:* Windscale #1, Windscale, England, natural uranium, graphite moderated, air cooled reactor, used for plutonium production.

Date: September 1952.

Nature of Incident: Unexpected release of energy accumulated in the graphite blocks, manifested as an increase in the temperature of the graphite pile.

Radiation Level: Not reported.

Injuries. No overexposure or injuries reported.

Evaluation: This was an unexpected minor occurrence which did not result in any officially reported or otherwise known consequences to the health and safety of the personnel or the public. It alerted the plant management to the "Wigner effect," the accumulation of energy in graphite subject to irradiation, and led to the development of procedures or periodic deliberate releases of Wigner energy. See item 25.

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